UNIVERSITY OF ALBERTA

Interpreting the Magnitude and Meaning of Trauma Pain

by

Marilyn Jean Hodgins ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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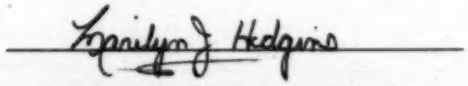

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Abstract

Pain has been a major focus in health research for over a quarter century. During this time, a proliferation of tools have been developed to measure this complex phenomenon. The validity of these tools has generally been established based on their ability to function predictably. Few attempts have been made to uncover the meaning of subjects' scores on these tools, or the implications of these scores for clinical decision-making. Until this knowledge is available, pain measurement tools, such as the visual analogue scale (VAS), will not attain the clinical status awarded vital signs, such as blood pressure, pulse, respirations, and temperature. The purpose of the present study was to describe the magnitude and meaning of the pain experienced by trauma patients during their treatment in the emergency department. To address this purpose, patients rated their pain using a 100-millimeter VAS every 20 minutes and interpreted whether or not their pain was at an acceptable level at each occasion. In addition, non-invasive physiological monitoring was conducted of patients' electrodermal and electromyography activity, skin temperature, and pulse rate. Data were collected on a convenience sample of 30 stable, trauma patients.

Pain was generally interpreted as an expected and acceptable consequence of trauma. It was also a very dynamic phenomenon as approximately 65 percent of consecutive pain scores reflected a change in intensity. Three-quarters of patients reported episodes of unacceptable pain. Median VAS score for the patient-defined, cut-point between acceptable and unacceptable trauma pain was 72.5 (range 0 to 100). Patients' interpretations of this point remained relatively stable throughout the period of data collection. Patients interpreted acceptable pain using criteria related to individual

characteristics (e.g., past pain experience), nature of noxious stimulus (e.g., responsibility for injury), and situational factors (e.g., business of department). Weak evidence was found to suggest that muscle activity as measured by electromyogram may reflect the pain experienced by men. Based upon the findings, it is recommended that researchers, clinicians, and patients work collaboratively to establish guidelines for interpreting the meaning of pain scores in various clinical situations and for linking these scores to treatment goals.

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Chapter One
- INTRODUCTION -

The assessment and management of pain is generally recognized as a fundamental nursing activity. Effective pain management is also identified as a desired goal or outcome of nursing practice (Ferrell, 1999; Hudak, Gallo, & Morton, 1998; Smeltzer & Bare, 1996). Steps involved in the effective management of pain include thorough and accurate assessment, the appropriate choice and administration of treatments, and the ongoing evaluation of the outcomes. One of the most important aspects of this process is the measurement of the pain experience. Without information about the patients' pain experiences, it is difficult for clinicians to make informed decisions that will guide their actions.

Three factors complicate the measurement of pain. The first and perhaps most challenging of these is the nature of pain itself. Pain is a multi-dimensional, subjective phenomenon that varies greatly across individuals, situations, and time. The perception of pain is multi-dimensional in that it represents a culmination of sensory, evaluative, and emotional processes (Melzack & Wall, 1965). Pain also has a social component in that many pain beliefs, attitudes, and behaviours occur as a result of our observations and interactions with others (Zborowski, 1969).

A second complicating factor occurs as a result of current deficiencies in the instruments used to measure this phenomenon. Measurement tools[1] are created to expeditiously and accurately quantify the kind or amount of an attribute present at a given point in time. This information can assist in clinical decision-making if patients' scores on these tools are trustworthy, accurate, and meaningful. For example, the sphygmomanometer is one of the most commonly used tools in the delivery of health care. This tool measures blood pressure (BP) or the pressure exerted by the blood on the walls of the arteries. Patients' BP scores are expressed as the ratio of the systolic pressure (i.e., peak pressure occurring when ventricles of the heart contract) over the diastolic pressure (i.e., pressure existing in vessel walls when ventricles are at rest). Acceptable scores for adult BP range from 100/60 to 140/90. Values that fall outside this range are generally deemed unacceptable and indicative of a need for further investigation and intervention. Measurements on this tool have clinical utility because health care professionals have a common understanding of how BP scores are obtained and interpreted.

Currently, scores on pain measurement tools lack this level of common agreement. Even though many pain measurement tools have been extensively used in research and their use in clinical practice is strongly endorsed, there is little agreement in terms of the

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[1] The terms measurement instrument, tool, and scale are used interchangeably throughout this document

clinical meaning or importance of their scores. Consequently, it is difficult for clinicians (or researchers) to interpret which scores warrant intervention and which indicate the effective management of pain. For example, do all patients who score their pain as "mild" on a categorical scale or less than 30 on a 100 millimetre (mm) Visual Analogue Scale (VAS) have acceptable pain control? Alternatively, should pain scores be interpreted on the basis of patients' reports of satisfaction with treatment or willingness to accept their current status? Perhaps pain scores should be interpreted differently depending on the clinical situation or type of pain. But if so, how should this be determined? Currently, there are no answers for these important questions. However until these questions are answered, the clinical utility and relevance of pain measurement tools are significantly reduced.

A final complicating factor is the lack of specificity in current treatment goals for the management of pain, and the lack of association between treatment goals and the scores on pain measurement tools. A useful treatment goal is one that lacks ambiguity and vagueness and clearly defines the desired end-in-view as well as the time frame for its attainment (Paul & Reeves, 1995). Although the Agency for Health Care Policy and Research's (AHCPR) guideline for the management of acute pain (operative or medical procedures and trauma) states that the prevention of pain is always preferable, it also acknowledges that this may not always be attainable (Acute Pain Management Guideline Panel, 1992). In these situations, the AHCPR endorses a goal of "adequate relief of pain" (p. 4). Unfortunately, directions are not offered for interpreting what non-pain-free states are acceptable in which clinical situations as measured by a specific pain measurement tool. Criteria are needed that clearly define what constitutes acceptable pain in situations in which it can not be prevented and/or the process to use in defining this state. The availability of such criteria would expedite clinical decision-making as well as increase professional accountability for the attainment of effective pain control.

In summary, pain management practices will not improve until meaning is attached to patients' scores on pain measurement instruments, and linkages are established between these scores and treatment goals. Until criteria for interpreting what constitutes acceptable pain as measured by the various pain scales are available, research will continue to uncover poor pain management practices. Research is needed that examines issues such as: (1) What constitutes acceptable pain? and, (2) what factors make pain unacceptable to patients and/or to health care professionals? These issues were addressed in the present research in the context of the pain experienced by stable trauma patients.

Context of the Pain Experience

As stated earlier, the experience of pain is highly variable across individuals as well as situations. The context in which pain is experienced not only affects how the person-in-pain perceives and responds to it, but also how others respond to that person. To date, pain management practices within the emergency department have not been adequately studied. However the importance of pain management in the emergency care of patients

was recently acknowledged at the First International Symposium on Pain Research in Emergency Medicine (Ducharme, 1996).

The emergency department is unique from all other hospital units in that it simultaneously functions as an intensive care unit, physician's office, crisis centre, and, increasingly, an inpatient unit. Emergency departments are characterized by a high degree of uncertainty in that patients of all ages with diverse, undiagnosed health problems arrive with little or no warning. No matter how many patients are in the department at any given time or how short-staffed the department is, patient volumes may continue to increase. Even when ambulances are re-routed to other health care facilities, people can still walk into the department. Many of these walk-ins may be as acutely ill or injured as the patients who arrive by ambulance.

The environment of the emergency department is specifically designed and equipped to maximize mobility so that rapid fluctuations in patient volumes and acuity-levels can be accommodated. To facilitate patient flow and movement, the emergency department is routinely equipped with stretchers rather than beds and wheelchairs rather than chairs. It is common practice to relocate patients from one area of the department to another during their treatment in most emergency departments.

Each year, many emergency visits occur as a result of trauma. Trauma is a major source of morbidity and mortality in Canadians, particularly among those aged one to 40 years (Statistics Canada, 1998). Trauma is an unintentional or unexpected injury caused by an uncontrolled destructive force that results in specific and possibly generalized tissue damage. Tissue damage may occur immediately as skin, subcutaneous tissues, nerves, blood vessels, muscles, and/or bones are cut, crushed, stretched or manipulated, or later as a result of the over-distension of tissues from hemorrhage or edema or the result of exposure to the contents of ruptured cells (Stanik-Hutt, 1993). Such tissue damage generally results in the sensation of pain. Despite this, few studies have examined the pain experience of trauma patients, especially during the initial emergency phase (Christoph, 1991; Dempster, 1995; Mitchell, Shurpin, & Gallo, 1989; Smeltzer, 1988; Stanik-Hutt, 1993; Tanabe, 1996). Without such knowledge, it is difficult to evaluate the quality of the care provided or identify areas needing change.

Study Purpose

The purpose of this study was to examine the pain experience of stable trauma patients during their stay in the emergency department. More specifically, the study was designed to: (1) examine how patients interpret the magnitude and meaning of the pain that they experience immediately following traumatic injuries, and (2) explore the physiological responses that occur in conjunction with changes in patients' interpretations of their pain. Knowledge about the physiological responses to pain is necessary because many patients can not verbalize their pain (for example, unconscious, critically-ill, and pre-

verbal). As continual improvements are made to the technologies available for monitoring patients' status, clinicians are able to monitor a number of physiological parameters simultaneously and to examine trends or patterns rather than isolated measures. Understanding the relationship between verbal and physiological pain responses may enhance the ability to manage pain in those who are unable to verbalize this experience.

Chapter Two
- Review of the Literature -

Assessment or measurement of pain is an essential pre-requisite of effective pain management. Unfortunately as introduced in the preceding chapter, this process is complicated by several factors. First, it is complicated by the nature of pain. Pain is a highly subjective and dynamic phenomenon. A second complicating factor occurs due to deficiencies in the instruments used to measure pain. Patients' scores on these tools currently lack meaning. Finally, treatment goals for the management of pain lack specificity. Goals are needed that clearly define the desired end points or outcomes, or that provide direction for goal-setting in a particular clinical situation. A major premise underlying this study is that clinical decision-making regarding the management of pain would improve if scores on pain measurement tools were explicitly linked to treatment goals.

This chapter begins with an overview of the theoretical and research basis for each of the preceding factors. In the concluding section of this chapter, issues pertaining to the measurement and management of trauma pain are discussed.

The Nature of Pain

Pain is a personal experience. Realization of this fact leads to the adage that pain is whatever the person says it is and exists whenever the person says it does (McCaffery, 1968, as cited in McCaffery & Beebe, 1989). Few attempts have been made, however, to unravel how patients interpret the experience of pain, especially acute pain. Beecher (1956) first discovered the importance of meaning in his investigation of the pain experiences of soldiers wounded in battle. Beecher could find no dependable relationship between the extent of soldiers' wounds and their pain. Many soldiers with massive injuries expressed little pain until they were safely removed from the dangers of the battle field. However during their treatment at first-aid units, these soldiers reacted with normal or even heightened responses to the pain evoked by medical interventions. Beecher concluded that the intensity of the pain experience was largely determined by the emotional meaning and significance of the noxious event to the person. Beecher (1956, 1959) labelled this the reaction to pain.

The introduction of the Gate Control Theory by Melzack and Wall (1965) radically altered approaches to the investigation and management of pain. Melzack and Wall reiterated Beecher's belief that pain perception is not simply a function of the amount of physical injury. They proposed that the intensity and quality of pain are influenced by factors such as past experience, attention, expectation and anxiety, as well as the meaning of the situation in which pain occurs. Melzack and Casey later extended the Gate Control Theory to emphasize the multi-dimensional nature of pain perception and how it shapes the pain response (Melzack & Casey, 1966; Casey & Melzack, 1967). In this revised

model, cerebral processes were categorized as sensory-discriminative, motivational-affective, and cognitive-evaluative. The sensory-discriminative domain encompasses factors concerning the temporal pattern, location, and intensity of the pain. The aversive nature of the pain experience and the emotions evoked by pain are represented by the motivational-affective domain. Finally, the cognitive-evaluative dimension reflects how the person interprets or evaluates pain using factors such as past experience, probable outcome, and the meaning attached to the situation (Melzack & Wall, 1977; Melzack & Wall, 1988; Siegele, 1974). Although not clearly depicted in the Gate Control Theory, pain has a social dimension (Bates, 1987; Stannard, Puntillo, Miaskowski, Gleeson, Kehrle, & Nye, 1996; Zborowski, 1969). Pain "does not exist in isolation from the social and cultural milieu in which it occurs" (Benoliel, 1977, p.x).

Without discrediting the work of Melzack and Wall, Cleeland (1989) reported that in his research two dimensions accounted for most of the variance in patient's pain scores. He labelled these as the "sensory" (that is, severity) and "reactive" dimensions of pain, reflecting Beecher's earlier work. Cleeland went on to suggest that our understanding of the meaning of pain severity might be enhanced by collecting information on the reactive dimension of pain.

The Negative Effects of Pain

The unpleasant nature of acute and chronic pain can invade every facet of a person's life. During the experience of acute pain, which is the focus of this research, much of the pain response reflects activation of the autonomic nervous system. Physiologically, the substances released from injured tissues evoke the release of stress hormones. These hormones promote the breakdown of body tissue; increase metabolic rate, blood clotting, and water retention; and impair immune function. They also activate the sympathetic ("flight or flight") branch of the autonomic nervous system resulting in an increase in heart rate, respiratory rate, blood pressure, palmar sweating, and muscle tension. The utility of these signs in measuring pain is complicated because factors other than pain can evoke a similar response, the body accommodates to stressors over time so responses diminish, and certain drugs inhibit this response (for example, beta-blockers).

Psychologically, the experience of pain can precipitate a number of negative emotions including anxiety, fear, depression, and despair. These emotions may intensify activation of the sympathetic autonomic nervous system. Finally, negative social effects may occur as patients experiencing pain may be so distracted by it that they withdraw from interactions with others and pay little attention to what is happening around them.

Measurement and Interpretation of Pain

A pre-requisite to effective pain management is accurate measurement of the phenomenon. Measurement is the process of translating reality into numbers (Knapp,

1985). It involves assigning numbers or labels to a phenomenon in order to depict the kind or amount of an attribute that is present at a given point in time (Singleton, Straits, Straits, & McAllister, 1988; Waltz, Strickland, & Lenz, 1991).

To facilitate the measurement of pain, a proliferation of measurement tools have been and continue to be introduced. These tools have been developed to meet the needs of various groups based on their age, level of cognitive development, language or ethnic background, and physical or psychological capabilities. Despite the multitude of tools available, they can be categorized as generating either physiological, behavioural, or verbal measures. Verbal self-reports are generally viewed as most appropriate for the measurement of pain due to the subjective nature of this experience (Acute Pain Management Guideline Panel, 1992).

Establishing the reliability and validity of the inferences drawn from scores generated by these measurement tools is an essential component of tool development. Due to the dynamic and subjective nature of pain and the popularity of single-item pain scales, most of the psychometric testing in this area has focussed on the issue of validity rather than reliability (Hester, Miller, Foster, & Vojir, 1997). Many researchers have concluded that these instruments produce comparable measures of pain due to the moderate to strong inter-correlations among subjects' scores (Downie, Leatham, Rhind, Wright, Branco, & Anderson, 1978; Ekblom & Hansson, 1988; Jensen, Karoly, & Braver, 1986; Littman, Walker, & Schneider, 1985; Ohnhaus & Adler, 1975; Wallenstein, 1984; Woodforde & Merskey, 1972). Research has also generated evidence demonstrating the ability of these tools to function predictably (Beyers & Aradine, 1987; Duggleby & Lander, 1994; Warnock & Lander, 1998; Zalon, 1999). For example, patients' pain scores tend to gradually decline during the postoperative recovery period, despite significant inter-individual variability. Finally, a few researchers have examined the ability of these tools to discriminate between pain and similar, but distinct concepts such as anxiety (Hodgins & Lander, 1997; Lander, Hodgins, & Fowler-Kerry, 1992), fear (Beyer & Aradine, 1988), coping (Wilkie & Keefe, 1991), and depression (Watt-Watson & Grayon, 1989). Despite the apparent functional correspondence exhibited by the various pain scales, little is known about the actual meaning of scores on these scales. The significance of this deficiency is highlighted by Messick (1989) in his writings on validity.

Messick (1989) believed the focus of validity testing should be broadened to include the meaning of subjects' scores on a measurement tool rather than the tool itself. According to Messick, a knowledge base should be established that not only guides the use of a measurement tool, but also advances our understanding of the meaning of scores on the tool. Guidelines are needed that outline: (1) the meaning, relevance, and utility of subjects' scores on a measurement instrument for a particular purpose, (2) the implications of these scores for decision-making and action, and (3) the functional worth of these scores as evidenced by the consequences of their use. He depicted this conceptualization of validity in the form of a progressive matrix (Table 1).

Table 1

Matrix Depicting the Facets of Validity

	Test Interpretation	Test Use
Evidential Basis	Construct Validity	Construct Validity + Relevance/Utility
Consequential Basis	Value Implications	Social Consequences

(Messick, 1989, p.20)

The establishment of construct validity is viewed as a necessary, but insufficient step in this validation process. Although construct validity studies generate the evidence and rationale to support the trustworthiness of score interpretation, they do not provide sufficient information about how subjects' scores on a tool ought to be used.

Messick emphasized that contextual factors can seriously confound the use and interpretation of scores on a measurement instrument. Identical scores on a measurement tool may be treated very differently depending on the situation. For example, higher scores on a pain measurement tool may be interpreted as acceptable immediately following a traumatic injury, but unacceptable if they persist over time. It is important, therefore, to consider the relevance and utility of scores on a measurement tool in specific situations with various population groups.

The consequential basis of validity testing addresses the value implications and outcomes that occur as a result of interpreting and using measurement scores. Messick believed that validity and values can not be separated. The value systems of the researcher and/or clinician who use the measurement tool inevitably bias the inferences derived and actions taken. For example, a clinician who believes that pain builds character is more likely to interpret higher pain scores as acceptable than someone who considers this a pain myth. Consequently, it is important to uncover the underlying value system(s) operating in a specific context, and to determine their potential impact on the interpretation and use of measurement scores.

The last cell in Messick's validity matrix addresses the social consequences of test use. Because measurement is conducted for a specific purpose, it is important to examine the extent to which this purpose is realized. Consideration should be given to the various costs, both material (for example, financial, human resources, and time) and those less tangible (for example, stress and stigmatization), incurred with the measurement process. According to Messick, the best ways to prevent or minimize negative consequences is to eliminate irrelevant content from the measurement tool and maximize the empirical basis for score interpretation and use.

Interpreting the Meaning of Pain Scores

Attaching meaning to patients' scores on pain measurement tools poses challenges. The first challenge is simply the necessity for patients to convert a complex, subjective experience into an objective number or label (Carlsson, 1983; Chapman, Donaldson, & Jacobson, 1992; Ohnhas & Adler, 1975). Relevant questions include: What factors impact on patient's ability to perform this task? and, what factors do patients consider when making this conversion? A second challenge is to establish a process for interpreting the meaning of these scores. Although it has been suggested that such knowledge comes with repeated use and familiarity with a tool (Kazis, Anderson, & Meenan, 1989; Jaeschke, Singer, & Guyatt, 1989), this wait-and-see approach is extremely inefficient especially if a tool is to be used in the practice setting. Why should busy clinicians spent time and effort measuring a phenomenon if no tangible benefits are forthcoming?

The current lack of criteria for interpreting scores on pain scales creates problems when discussing the meaning and consequence of research findings for practice. The discussion of findings in pain research is frequently limited to reporting whether or not there is a statistically significant difference in mean scores between treatment groups. It has long been recognized, however, that a statistical significant finding may have little practical value (Dyer, 1997; Slakter, Wu, & Suzuki-Slakter, 1991). If research using these measurement tools is intended to affect a change in practice, several questions warrant consideration. These questions include: (1) What do specific scores or ranges of scores on a measurement tool represent? For example, what scores on a tool signify unacceptable pain? (2) What magnitude of change on a scale warrants action? Does this magnitude vary depending on the region of the scale being used? For example, is a 3-point change from 6 to 9 (on a 11-point numerical scale) more important than one from 1 to 4? And finally, (3) how can effective pain management be defined in terms of patients' scores on these tools?

Four general approaches for interpreting the meaning of scores on measurement instruments have been discussed in the literature. Although various labels have been used, these approaches are frequently referred to as: statistical, normative, comparative, and social validation (Estabrooks & Hodgins, 1996; Hayes & Haas, 1988; Lefort, 1993; Lydick & Epstein, 1993). Using the statistical approach, meaning is attached to research findings based on a sample-derived, statistical calculation such as effect size, confidence interval, or median score. Although some researchers may prefer to base their conclusions on the mathematics, the appropriateness of interpreting clinical meaning solely on the basis of a statistical calculation must be questioned. Alternatively, using the normative approach, meaning is attached based on reference values or scores observed in a normal or functional population. For example, the norms for blood pressure among various population groups (for example, adults, children, Canadians) are well established. The problems associated with this approach are the current lack of normative data for many health-related phenomena and the problem of identifying appropriate referent groups. A third approach to establishing clinical significance is the comparative or individual

approach. Using this approach, meaning is attached to subjects' scores on a measurement tool by comparing them with their scores on a "gold-standard" or external, objective criterion. For example, when the pulse oximeter was first introduced for monitoring respiratory (oxygenation) status, patients' oximetry scores were compared with scores obtained using the more expensive and invasive arterial blood gas method. Unfortunately, no "gold-standard" or "norm" exists to interpret the meaning of pain measurements except perhaps the absence of pain.

When gold standards or population norms are not available, researchers must rely on a social validation approach. Using this approach, opinions are solicited from others who by expertise, consensus, or familiarity are able to make a subjective evaluation or interpretation of the situation (Kazdin, 1982). A value judgment is made regarding what constitutes a meaningful score. A major challenge associated with the social validation approach is determining whose opinions or judgments to use. For example when interpreting the meaning of pain scores, input might be solicited from patients, significant others, health care providers, members of the general population, and/or other researchers. Considerable variability in the definition of what constitutes a meaningful score is likely to be obtained, however, depending on whose perspective is used. Although the solicitation of multiple perspectives may enhance the sensitivity of measurement scores, deciding how to deal with conflicting points-of-view poses a major challenge.

Some researchers have suggested that norms or standards regarding what constitutes a meaningful score can never be established, and that such values must be re-established in every study or in each clinical situation (Gill & Feinstein, 1994; Lefort, 1993). However if this is true, how can we advance our clinical knowledge base or establish standards for professional practice? Although these measurement issues will not be easily resolved, and may vary somewhat depending on the clinical situation and/or specific patient group, they must be addressed. Hopefully, through explication, replication and refinement, a process can be established that will assist in the interpretation of pain measurement scores.

Visual Analogue Scale

The Visual Analogue Scale (VAS) is perhaps the most extensively used measurement tool in clinical pain research. It is generally described as a simple, quick, and sensitive unidimensional measure of pain. Intensity is the pain dimension most often measured using this scale. In most situations, the VAS is presented as a 100 millimetre (mm) horizontal line with its two endpoints labelled as the extreme values of the phenomenon.

Psychometric Properties of the Visual Analogue Scale

Several critical reviews of the psychometric properties of the VAS have been

published (see, Gift, 1989; Langley & Sheppeard, 1985; McDowell & Newell, 1996; Wewers & Lowe, 1990; Waltz, Strickland, & Lenz, 1991). These reviews generally endorse the VAS as an appropriate tool for the measurement of subjective experiences, such as pain.

Moderate to strong correlations have been reported between subjects' pain scores on the VAS and their scores on other categorical pain scales. These correlations have ranged from .42 to .91 (Littman et al., 1985; Wallenstein, Heidrick, Kaiko, & Houde, 1980; Wewers & Lowe, 1990). The test-retest reliability coefficients for the VAS have exceeded .90 (Huskisson, 1983). Disregarding these significant results, Wewers and Lowe (1990) questioned the utility of a reliability measure on such a dynamic concept. They proposed that high reliability coefficients may simply reflect subjects' recall of prior scores. Dixon and Bird (1981) did observe however that reproducibility of previous marks varied along the length of the VAS such that extreme scores were more accurately recalled and reproduced.

Due to the dynamic nature of pain, the ability of an instrument to detect changes in patients' pain experience is important. The sensitivity of the VAS to detect change in patients' pain has been demonstrated in the evaluation of a variety of pharmacological and nonpharmacological procedures (Gift, 1989; Lander, Hodgins, Nazarali, McTavish, Ouellette, & Friesen, 1996; Melzack & Katz, 1994; Wallenstein, 1984). It is generally assumed that measurement tools with a larger range of possible scores, such as the 100 millimetre continuum of the visual analogue scale (VAS), are more sensitive than the discrete points available on categorical scales (Collins, Moore, & McQuay, 1997; Guyatt, Townsend, Berman, & Keller, 1987; McDowell & Newell, 1996). Recently this assumption was challenged by Streiner and Norman (1995) who labelled it the "illusion of precision" (p. 33). They proposed that the VAS' larger range of scores did not produce a representation of the underlying attribute to the degree of resolution suggested by the scale.

Several other measurement issues also need to be resolved in relation to the use of VAS pain scales. First, standards have not been established for labelling the VAS' two endpoints when measuring pain intensity. Although "no pain" is generally used as the lower anchor, various labels have been applied to the upper extreme [for example, "severe pain", "extreme pain", "unbearable pain", "worst pain ever", "pain as bad as it could be", and "worst pain possible"] (Huskisson, 1974; Langley & Sheppeard, 1985, McDowell & Newell, 1996). No study has critically examined how these labels affect patients' pain scores.

Whether or not subjects should see their previous VAS scores when serial pain measures are obtained is also a topic of controversy. Although reference to previous scores may bias future measurements, some researchers argue that permitting patients to view previous scores results in a more accurate evaluation of change (Guyatt, Townsend,

Keller, & Singer, 1989; Scott & Huskisson, 1979; Wewers & Lowe, 1990).

Concerns have also been expressed regarding the suitability of the VAS for some population groups. Variability has been reported in individuals' ability to use this tool (Carlsson, 1983; Sriwatanakul, Kelvie, & Lasagna, 1982). Some studies have suggested that measurement error may increase with the age of the study population in that the elderly may experience more difficulty in interpreting and using the scale (Jensen et al., 1986). Other researchers have reported problems when using the VAS with acutely ill populations (Bondestam, Hofgren, Gaston-Johansson, Jern, Herlitz, & Holmberg, 1987; Hofgren, Bondestam, Johansson, Jern, Herlitz, & Holmberg, 1988; Puntillo, 1994). It has also been proposed that persons who have vision problems or who are experiencing difficulty concentrating may experience problems using this measurement tool (Bondestam et al., 1987).

Finally, specific scores on the VAS currently lack meaning. Although it can be interpreted that a VAS score of 40 is 10 units higher than one of 30, there are no guidelines for interpreting the significance of this score for clinical decision-making. For example, is 40 an acceptable level of pain or is action (intervention) warranted? Without this knowledge, the clinical utility and relevance of the VAS is significantly reduced.

Attaching Meaning to VAS Scores

In a few studies, meaning has been assigned to VAS scores in an apparently arbitrary fashion. For example, clinically significant pain was defined as VAS scores greater than 30mm by Seymour, Kelly and Hawesford (1996), as 60mm or more by Stubhaug, Grimstad, and Breivik (1995), and as equal to or greater than 75mm by Curtis, Gartman, and Green (1994). No rationale was offered for the establishment of any of these cut-points. A comparative approach was used by Collins et al. (1997) to establish a cut-point on the VAS to differentiate mild and moderate pain. These researchers contrasted patients' VAS scores with their ratings on a categorical pain scale (no pain - mild - moderate - severe). After examining the distribution of VAS scores for 736 patients reporting moderate pain, Collins et al. concluded that VAS scores in excess of 30 mm indicate that patients were experiencing at least moderate pain. The authors did not attempt to translate their findings in terms of treatment goals. For example, should VAS scores greater than 30mm be interpreted as unacceptable and requiring intervention?

In an investigation of the effect of EMLA (Eutectic Mixture of Local Anesthetics), a topical anaesthetic cream used to reduce procedural pain, Lander et al. (1996) attempted to establish a cut-point to differentiate an acceptable from unacceptable outcome for children having venipuncture. A post hoc decision was made to use the sample median of 11mm (on 100mm VAS) as this cut-point. This decision was based on the observation that 90% of the children who spontaneously commented to the data collectors that they had experienced "no pain" had a VAS score below the sample median. Apparently, some

children gave a non-zero VAS score even though they verbally reported an absence of pain.

Researchers have also attempted to attach meaning to pain scores by examining the difference between measurements. For example in an earlier study, Lander et al. (1992) attempted to define what constitutes a meaningful score in children's procedural pain in terms of accuracy of measurement. They proposed that it is clinically significant when children's scores for the pain experienced differ by ten percent or more from their expected pain scores. It was postulated that these children may experience more difficulties coping with pain-producing procedures. No rationale was offered however for the establishment of this criterion.

Measurement error was used by Carlsson (1983) to determine the magnitude of change between VAS scores that was meaningful to patients with chronic pain. Subjects estimated the lengths of five randomly selected lines after being shown a reference line of 100mm length. The standard deviation of the sum of errors-of-estimates was labelled "visual inaccuracy" and was used to indicate margin of error. Based on these scores, unchanged pain was defined as a score differing $\pm$ 6 mm or less from the preceding measure.

Finally in a study of trauma patients, Todd, Funk, Funk, and Bonacci (1996) concluded that a mean difference of 13 mm on a VAS was the minimum clinically important difference (MCID). VAS pain measures were recorded every 20 minutes for up to two hours. At the same time, subjects indicated the degree of pain relief experienced since the last measure, using a five-point Likert scale (much less - little less - about same - little more - much more). The MCID was calculated based on the mean change between two consecutive pain scores (i.e., pain contrast) associated with a global rating of a little less or a little more pain. No rationale was offered to explain why this difference should be interpreted as a MCID rather than a detectable, but trivial change.

Most of these attempts to infer meaning to VAS scores utilized a post hoc approach - decisions were made after the data were collected. A potential problem with such an approach is that the findings may be manipulated to reflect the specific sample rather than the general population. If pain measurement tools, such as the VAS, are to help guide clinical decision-making, explicit *a priori* guidelines for interpreting scores need to be empirically derived and tested.

Goal Setting and Effective Pain Management

An unwritten assumption apparent within the literature is that pain management would improve if pain scales were utilized in clinical practice. Although the use of pain scales might increase the visibility of pain, their full potential will not be realized until treatment goals are established which define what constitutes acceptable pain as measured

by these scales.

Goals are the desired outcomes or end-points of an action (Bradley, Bogardus, Tinetti, & Inouye, 1999). In the AHCPR's (1992) clinical practice guidelines for the management of acute pain, four treatment goals are identified: (1) reduce incidence and severity of patients' pain, (2) educate patients about importance of communicating unrelieved pain, (3) enhance patients' comfort and satisfaction, and (4) help reduce complication rates and length of hospital stays. Good (1998) proposed that the utility of the AHCPR guidelines is reduced because these treatment goals are not in a testable form.

Recently, some work has been done to express the goals of pain management in terms of outcomes such as quality of life, functional status, and satisfaction with treatment (Hester et al., 1997; Ward & Gordon, 1994). Serlin, Mendoza, Nakamura, Edwards, and Cleeland (1995) attempted to interpret the meaning of cancer patients' ratings of pain severity by linking these scores with measures of the extent that pain interfered with their functional status. Serlin et al. reported a non-linear relationship between pain severity on a numerical rating scale (0-10) and interference with enjoyment of life, activity, mood, walking, sleep, work, and relations with others. They found the intervals between "four and five" and between "six and seven" on the numerical rating scale were more significant than other intervals in terms of the impact on interference of functional status.

Patient satisfaction with treatment has also been used as an outcome measure with mixed results. Little relationship was reported between pain severity and patient satisfaction in Ward and Gordon's (1994) study of 248 hospitalized patients. Conversely, Desbiens et al. (1996) reported that dissatisfaction with pain control was more likely among patients with higher pain severity, greater anxiety, depression and alteration of mental status, and lower reported income. In a study of 91 post-operative patients, Thomas, Robinson, Champion, McKell, and Pell (1998) found that younger, female patients with high pre-operative pain, high anxiety, low pain expectations, and high willingness to report pain were more likely to report dissatisfaction with pain relief.

Further work is needed to establish explicit linkages between patients' scores on pain scales and treatment goals. To facilitate such work, Good and Moore (1996) conceptualized a middle range theory for the management of acute pain. Good (1998) summarized their theory as:

> To achieve a balance between analgesia and side effects in adults with moderate to severe acute pain, the nurse should administer potent pain medication plus pharmacologic and non-pharmacologic adjuvants. The nurse should assess pain and side effects regularly, and teach patients to participate. If *unacceptable* relief or side effects are experienced, the nurse should intervene, reassess, and reintervene if necessary to meet the relief goal *set by the patient* (p.120) [italics added for emphasis]

According to this theory, goals regarding acceptable pain are defined entirely by the patient. This proposition is congruent with the conceptualization of pain as a subjective experience that can only be known by the person experiencing it. Despite the validity of this statement, it is also true that many factors may impair a person-in-pain's ability to make an informed decision. The person-in-pain may lack sufficient knowledge about pain and available treatment options. In addition, he/she may be unduly influenced by contextual factors. For example, people who enter a busy emergency department may devalue the importance of their pain or its relief because of activities happening around them. Due to the attention-demanding quality of pain, it is also questionable whether persons experiencing severe pain can absorb, process, and filter information necessary to make an informed decision. Consequently, assistance may be needed if these individuals are to make informed decisions about their pain and its management.

Relationship between Verbal and Physiological Pain Responses

A reality of clinical practice is that not all patients can provide verbal reports of their pain (e.g., unconscious, critically-ill, and pre-verbal patients). This seriously hampers efforts aimed at the management of pain. Alternative approaches are therefore needed to measure pain in situations where it is impossible to ascertain patients' verbal reports. Little is known about the relationships among verbal pain reports and the various physiological responses to pain (Puntillo & Wilkie, 1991; Stanik-Hutt, 1993). To date, most of the research examining the relationship between pain and physiological responses has been conducted within the laboratory environment on healthy adult males, and has generated contradictory findings. Distinct differences have been observed between the verbal and autonomic (i.e., electrodermal activity and vasomotor activity) response patterns exhibited by healthy men and patients with low back pain in a comparative study of the responses to experimental nociceptive stimulation (Opavsky, Dostalek, & Maracek, 1991).

In a study of subjects' responses to varying intensities of cutaneous heat, Moltner, Holzl, and Strian (1990) observed a tendency for subjects' heart rates to increase as higher levels of pain were reported. Other studies have also reported positive relationships among blood pressure reactivity, the severity of the pain stimulation, and patients' verbal pain responses (Bruehl, Carlson, & McCubbin, 1992; Hampf, 1990). Conflicting findings have been reported, however, regarding the relationships among measures of skin conductance, skin temperature, and subjects' verbal pain scores (Lowling, 1982; Hampf, 1990). In one of the few clinical studies, Bernstein, Garzone, Rudy, Kramer, Stiff, and Peitzman (1995) found a significant positive relationship between trauma patients' serum beta-endorphin levels and the severity of their injuries as well as the physicians' ratings of the patient's pain. Surprisingly, no correlation was observed between the severity of patients' verbal pain ratings and their serum levels. Perhaps the magnitude of the physiological response is somehow affected by patients' interpretations of their pain experience. Clearly, further work is needed before physiological measures can be used as indirect indicators of pain.

Acute Traumatic Pain

The pain experienced following trauma prompts many people to access emergency health care services for the treatment of their injuries. Despite the prevalence of such emergency visits, little is known about the extent and severity of unrelieved trauma pain, especially during the initial emergency treatment phase (Stanik-Hutt, 1993). In a study designed to examine the onset, intensity, and quality of trauma pain, Melzack, Wall, and Ty (1982) interviewed 138 patients in the emergency department. Although 51 patients (37%) reported an absence of pain at the time of injury, almost all reported pain within one hour. Of the 87 patients who reported pain at the time of injury, three-quarters described their pain as distressing, horrible, or excruciating.

A high incidence of unrelieved pain was also reported by Roberts and Eastwood (1994) in their prospective study of 100 patients with fractures of the femoral neck. Global self-reports of the pain experienced since their injury were obtained within 24 hours of the patients' admission to hospital and prior to surgery. Only two patients reported no pain. Of the 98 who reported pain, 89 (90.8%) rated their pain as a seven or more on an eleven-point (0 to 10) numerical scale. Despite this, one-third of these patients received no analgesia during their stay in the emergency department. Similar findings were also reported by Arlbaster (1995) in a study of 32 men admitted to the emergency department with lower limb fractures. More than three-quarters of these patients received no analgesia in the emergency department. When these men recounted the pain experienced during their stay in the emergency department, they all rated it as "quite a lot", "very bad" or "as much as I could bear".

A number of factors may contribute to the under-treatment of trauma pain, many of which are common to all health care situations. The National Institute of Nursing Research (1994) conceptualized the problem in terms of factors specific to the patient and health care professional (i.e., physician and nurse), as well as contextual factors occurring at both the organizational and societal level. Patient-specific factors that negatively affect pain management practices include: (1) unrealistic expectations of pain and its relief, (2) inability to communicate pain, (3) faulty attitudes, beliefs, and behaviours concerning pain management, and (4) a lack of knowledge. Contributing factors related to health care professionals include: (1) a lack of knowledge which can be partly attributed to inadequate educational programs, plus (2) faulty attitudes and biases about pain. Organizational factors that perpetuate ineffective practices include: (1) a lack of emphasis on pain management, and (2) the absence of established quality control standards, such as guidelines for pain documentation. These organizational factors reduce professional accountability for the relief of pain and create an environment in which the experience of pain is often invisible (Max, 1990). Finally at the societal level, inadequate pain management is supported by the current opiophobia. An excessive fear of opioids prevails within the general population due to misconceptions about the nature and prevalence of drug addiction.

Within the emergency department, the management of pain is generally not considered a treatment priority until after the patient with traumatic injuries is hemodynamically stable. Unfortunately, "all too often [pain] is ignored completely even when the patient has been adequately stablized" (Caplan, Miller, & Turndorf, 1992, p.697). A factor that may contribute to this problem is that several reference texts define the goal of trauma pain management as reducing pain intensity to "tolerable" levels (see Caplan et al., 1992; Wooden, 1992). Although the use of the term "tolerable" suggests that some degree of pain is acceptable, little attention has been given to defining exactly what constitutes a "tolerable" state, or the process that should be used to define it.

Ethnicity of the patient has been linked to inadequate analgesic administration within American hospitals. In a retrospective study of patients admitted to an emergency department with isolated long-bone fractures, Todd, Samaroo, and Hoffman (1993) found that patients of Hispanic origin were twice as likely as Caucasians to receive no analgesics during their treatment in the emergency department. Ethnicity remained a strong predictor of analgesic administration even after controlling for patients' sex, primary language, insurance status, occupational injury, fracture reduction, time of presentation to the emergency department, duration of stay in the department, and hospital admission. Similar studies to investigate the affects of ethnicity on trauma pain management have not been conducted in Canada.

The type of facility may also affect pain management practices. Using a retrospective chart audit, Osswaarde (1997) reviewed the type, route, dose, time from admission to first analgesia, and number of consecutive doses given to 74 adult trauma patients admitted to a Level One emergency department and 65 admitted to a non-level One facility. Trauma Level One facilities are specifically designed and equipped for the aggressive management of trauma patients, and serve as referral centres for these patients. Ossewaarde concluded that time from arrival to administration of first analgesia was significantly shorter, and the quantity of medication administered significantly greater for patients admitted to the Level One emergency department than for those admitted to the non-level one facility.

Problems in trauma pain management practices may also stem from accepted traditions or norms of practice. A tradition of emergency care is to withhold treatments until after a diagnosis has been made. This practice is based on a belief that treatment may mask important symptoms, such as pain, resulting in a missed or incorrect diagnosis. This tradition represents a major problem for trauma patient as their pain may be intensified by diagnostic procedures (for example, physical assessment, positioning for x-rays). Although the necessity and/or value of this tradition has been challenged (Boisaubin, 1989), practices have been slow to change.

The importance of aggressive treatment to prevent or minimize the negative effects of pain is increasingly being recognized. Unrelieved pain delays recovery, hinders early

mobilization, prolongs hospital stays, and decreases patients' quality of life and satisfaction with care (Acute Pain Management Guideline Panel, 1992; Good, 1999). Ineffective pain management practices during the initial emergency period may also have long-term consequences. Research has recently suggested that poorly managed pain during the initial acute phase increases the incidence of chronic conditions such as post-traumatic stress disorders (Schreiber & Galai-Gat, 1993) and chronic pain syndromes (White, LeFort, Amsel, & Jeans, 1997). Further research is needed to unravel the complexities of trauma pain management within the emergency setting.

Chapter Three
- METHOD -

Purpose

Because little is known about pain management within the emergency department, the purpose of this study was to describe the magnitude and meaning of the pain experienced by trauma patients during their treatment in the emergency department. The specific study objectives were: (1) to describe how patients interpret the magnitude and meaning of the pain associated with traumatic injuries, and (2) to examine the physiological responses that occur in conjunction with changes in patients' interpretations of their pain.

Research Questions

The research questions addressed in this study were:

1. How do stable, trauma patients interpret the severity of their pain and how does it change during their stay in the emergency department?
    i) What is the severity (magnitude) of their pain, and how does it change during the patients' stay in the emergency department?
    ii) What factors do patients perceive affect change in their pain?

2. What do trauma patients interpret as acceptable pain severity?
    i) What scores on the visual analogue scale do patients interpret as acceptable?
    ii) How do patients describe unacceptable pain?

3. What physiological indicators of increased activation of the sympathetic autonomic nervous system are associated with changes in patients' interpretations of their pain? For example, is there a(n):
    i) increase in electromyography activity (EMG)?
    ii) increase in electrodermal activity (EDA)?
    iii) increase in pulse rate (PULSE)?
    iv) decrease in skin temperature (TEMP)?

Assumptions

Messick (1989) believed that researchers should acknowledge their underlying value systems as they inevitably bias the inferences derived and actions taken. Following the review of the literature, several assumptions were formulated which influenced the planning, execution, and interpretation of this study. These assumptions include:

1. Pain is a subjective experience that varies greatly across individuals, situations, and

time.

2. Many factors affect how a person interprets and responds to the experience of pain.

3. Even though the eradication of pain may be the optimum treatment goal, some pain may be interpreted as acceptable by patients and health care professionals in some clinical situations.

4. When conducting research in an active clinical setting, such as the emergency department, the needs of patients and clinicians take precedence over those of the researcher.

Setting

The study was conducted in a university-affiliated, tertiary care, trauma Level One emergency department located in a large urban community in western Canada. Tertiary care hospitals are health care facilities that serve as referral centres for patients with complex or unusual health problems (Ellis & Hartley, 1998). Hospitals that are designated as Trauma Level One make a commitment, in terms of personnel and equipment, to the rapid assessment and management of seriously injured patients. In these facilities, skilled clinicians are available on a 24-hour basis to respond to the needs of patients with multiple, complicated injuries (Cardonna, Hurn, Mason, Scanlon-Schilpp, & Veise-Berry, 1988).

The number of emergency visits and major trauma cases treated by the emergency department during the period of 1996 to 1998 are summarized in Table Two (Capital Health, 1999). These data indicate that the department experienced an increase in patient volumes and acuity-levels during this two year period.

Table 2

Emergency Department Statistics for Number of Patients Treated

	1996/1997	1997/98
Emergency Visits	58,347	60,773
Major Trauma	567	680

Sample

Subjects were enrolled into the study between July and October, 1997. Data were collected on a convenience sample of hemodynamically and neurologically stable, trauma patients. Trauma is an unintentional or unexpected injury caused by an uncontrolled,

destructive force which results in specific and possible generalized tissue damage (Stanik-Hutt,1993). In the majority of cases, such tissue damage results in the sensation of pain.

Inclusion Criteria

The population consisted of patients 17 years of age and older admitted to the emergency department following a traumatic injury. To complete the interview component of the study, it was necessary that patients comprehend and speak English. Patients who were hemodynamically unstable as indicated by a systolic blood pressure less than 100mmHg (millimetres of mercury) were not included in the study. Patients experiencing significant alterations in their level of consciousness as a result of the trauma or substance abuse were also not enrolled. Because Glasgow Coma Scale (GCS) scores lower than 13 generally indicate moderate to severe alterations in neurological status (Cardonna et al., 1988), patients were enrolled into the study only if their GCS score was 13 or higher.

Selection Strategy

A convenience sample of patients admitted to the emergency department following a traumatic injury was obtained. Patients were enrolled into the study as soon as possible after their arrival in the department. No attempt was made to control for the time elapsed since the traumatic injury. Since hypothesis testing was not conducted in this study, a statistical power calculation was not done to determine an appropriate sample size. Instead, data collection continued until the researcher perceived that no new themes were emerging in relation to the criteria used by patients to describe and interpret their pain. In terms of physiological monitoring, an attempt was made to obtain data for a minimum of ten patients.

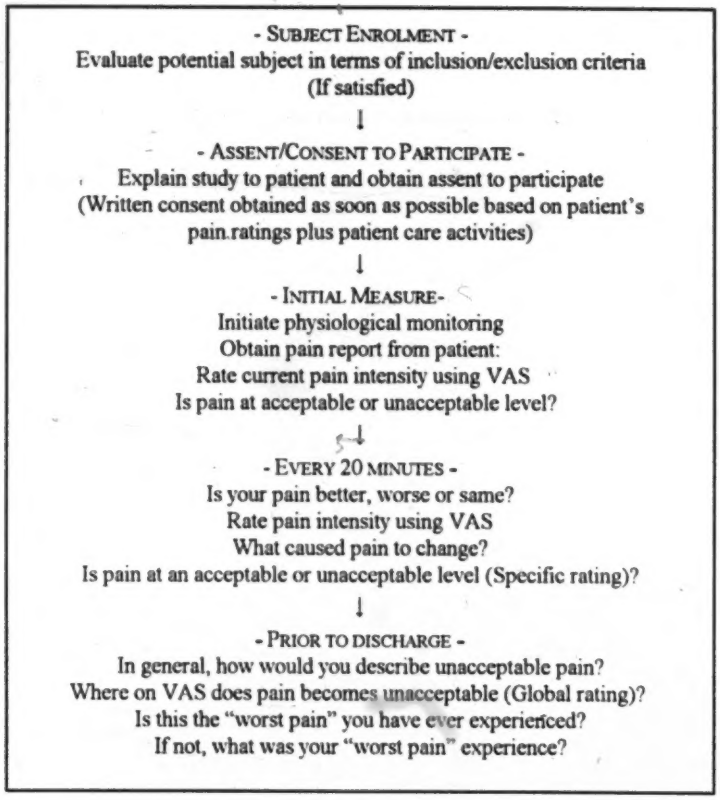
If the patient satisfied the inclusion criteria and with the emergency nurse's approval, the researcher approached the patient. Subject recruitment was conducted on a first-come, first-approached basis during periods when the researcher was in the department. During the period of data collection, the researcher spent approximately eight hours a day, seven days a week, in the department. Because patient volumes within the department tended to be higher during the afternoon and evening hours, the researcher scheduled her hours accordingly. Only one patient was enrolled in the study at any time. Once a patient was enrolled, the researcher remained with that individual for a period of four hours or until his/her discharge or transfer from the unit (whichever occurred first).

Study Design and Protocol

Pain assessment is a routine component of patient care. The protocol for this descriptive study built on this normal practice to examine the magnitude and meaning of the trauma pain experience as interpreted by patients during their treatment in the emergency department. The study protocol is summarized in Figure One.

Figure 1.

Study Protocol


- SUBJECT ENROLMENT -
Evaluate potential subject in terms of inclusion/exclusion criteria
(If satisfied)
- ASSENT/CONSENT TO PARTICIPATE -
Explain study to patient and obtain assent to participate
(Written consent obtained as soon as possible based on patient's pain ratings plus patient care activities)
- INITIAL MEASURE-
Initiate physiological monitoring
Obtain pain report from patient:
Rate current pain intensity using VAS
Is pain at acceptable or unacceptable level?
- EVERY 20 MINUTES -
Is your pain better, worse or same?
Rate pain intensity using VAS
What caused pain to change?
Is pain at an acceptable or unacceptable level (Specific rating)?
- PRIOR TO DISCHARGE -
In general, how would you describe unacceptable pain?
Where on VAS does pain becomes unacceptable (Global rating)?
Is this the "worst pain" you have ever experienced?
If not, what was your "worst pain" experience?

Interviews

Several questions were used to investigate how trauma patients' interpret the magnitude and meaning of their pain. During the first measurement period, the patient was instructed on the use of the visual analogue scale (VAS). Patients were then asked to rate the current severity of their pain and to indicate whether or not their pain was at an acceptable level. During the planning stages, several adjectives were considered in terms of their utility as a subjective criterion for interpreting pain. Examples of these adjectives included tolerable, satisfactory, adequate, good enough, understandable, bearable, and expected. It was recognized that the adjective used could affect patients' interpretations of their pain. The term acceptable was selected as the interpretative criterion. Acceptable was the adjective used by Good and Moore (1996) in their theory for the management of acute

pain. The Canadian Oxford Dictionary (Barber, 1998) defines acceptable as something which is pleasing, welcome, adequate, satisfactory, or tolerable.

The protocol indicates that pain measurements be repeated every twenty minutes. During these measurements, the following questions were to be asked: (1) Is your pain better than, worse than, or the same as the last measure? (2) Using the VAS, rate the current severity of your pain? To increase accuracy of the pain ratings, the patient's last pain score was reproduced on the VAS line so that it could be used as a referent point for estimating any change. (3) What caused your pain to change? And, (4) right now, is your pain at an acceptable or unacceptable level. This rating was labelled the Specific Rating of Acceptability? Although every attempt was made to adhere to the 20 minute time interval, it was occasionally necessary to adjust this interval so as not to interfere with patient care.

Four additional questions were asked prior to the patient's discharge or transfer from the department: (5) Using an unmarked (new) VAS, place a mark on the line at the point at which pain becomes unacceptable. This point was referred to as the Global Rating of Acceptability. (6) In general, how would you describe unacceptable pain? And finally, (7) was this the "worst" pain you have ever experienced? (8) If not, what was? Subjects' responses to these questions were tape-recorded to improve the quality of the data collected.

Physiological Monitoring

Non-invasive, continuous physiological monitoring was conducted of the patients' electrodermal activity (EDA), muscle activity as measured by electromyography (EMG), skin temperature (TEMP), and pulse rate (PULSE). Each of these measures reflects activation of the sympathetic branch of the autonomic nervous system that occurs almost immediately after exposure to a stressor, such as pain. Electrodermal activity (EDA), also known as Galvanic Skin Reflex, reflects the skin's ability to conduct an electrical current. It has been postulated that increased activity in the sympathetic nervous system causes increased hydration in the sweat ducts that reduces skin resistance to the conduction of electric activity (Hudgahl, 1995). In other words, an increase in sweat gland activity results in increased electrical conductance. Muscle tension is also a common response to stress. The electromyogram (EMG) records action potentials within striated muscle fibres which occur prior to the actual contraction and relaxation of the muscle (Hugdahl, 1995). Increased muscle activity results in increased electrical activity. Activation of the sympathetic branch of the autonomic nervous system also constricts peripheral blood vessels to shift blood to the vital organs. As the flow of blood to the periphery decreases, the temperature of the skin drops. Finally, it is generally accepted that activation of the sympathetic system results in an increase in pulse rate. Despite this, little is known about the actual changes in patterns or trends which occur in the cardiovascular system in response to the experience of acute pain (Ho, Spence, & Murphy, 1996).

Additional Information

Field notes were kept of all medications and/or procedures received by the patient. Any activities or events that might have affected the patient's pain experience were also documented. Examples of documented events included: changes in patient's activity level, presence of significant others, physical examination of injured area by health care professionals, and diagnostic or treatment procedures. Demographic information regarding the patient's age, level of education, mechanism of injury, and diagnosis were obtained from the patient's chart or by direct questioning.

Instrumentation and Measurement of Variables

Pain Intensity Rating Scale

Despite the unresolved issues regarding the use and interpretation of the VAS, a decision was made to use this scale. This decision was reached due to the popularity of the tool. Given the frequency of its use in research and practice, establishing a knowledge base to interpret the meaning of scores on the VAS should be viewed as a research imperative.

A 100 millimetre (mm), horizontal Visual Analogue Scale with the anchors of "no pain" and "worst pain possible" was used to measure pain severity. Subjects completed the tool by placing a mark on the line at a point which corresponded to their level of pain. Scores on the VAS were calculated by measuring the distance, in millimetres, from the lower border of the line to the subject's mark. Scores on the 100mmVAS could range from zero to 100.

Physiological Measures

A J&J I-330 computerized physiological monitoring system was used to monitor patients' physiological responses. This monitor was connected to a 386-SX lap-top computer. Both the physiological monitor and computer were mounted on a small, mobile cart.

Continuous monitoring of electrodermal activity, electromyography, pulse rate, and skin temperature was conducted. Small, non-invasive skin electrodes or sensors were attached to the patient's lower arm and hand. The non-dominant arm was used unless unaccessible due to injury or treatments (for example, intravenous access site or blood pressure cuff). All monitoring sites were prepared by cleansing the skin with an alcohol swap to improve data quality. As recommended by the manufacturer, conductive gel was used with the skin electrodes for EDA and EMG monitoring to improve the quality of data recording. The system was programmed to average and record readings every five seconds. J&J Enterprises (1988) reported the degree of accuracy of their physiological

monitors as three percent for the EMG, EDA, and skin temperature, and two percent for pulse rate.

Electrodermal activity. A J&J computerized, dermograph module model T-601 was used to monitor palmar skin conductance response. Two active silver/silver chloride electrodes were attached to the palmar surface of the second phalange of the index and middle fingers with velcro strips. The unit of measurement for EDA is micromho (μmho). Skin conductance levels generally range from .5 to 50 μmho/cm^2 when two active skin electrodes are used. However because of the high degree of inter-individual variability, norms for interpreting EDA readings have not been established.

Electromyography. EMG levels were measured using a J&J computerized, electromyograph module model M-501. The frontalis flexor muscle of the lower arm was used with two recording electrodes placed over the muscle (Figure Two) (Hugdahl, 1995). Both electrodes were active in relation to the ground electrode which was situated over the olecranon process. Electrodes were secured to the skin with hypo-allergenic tape. The following guidelines have been used for evaluating relative muscle tension: tense $\geq$ 2μV (kilovolts), normal between 1 and 2 μV; and relaxed $\leq$ 1μV (Rodger, 1995).

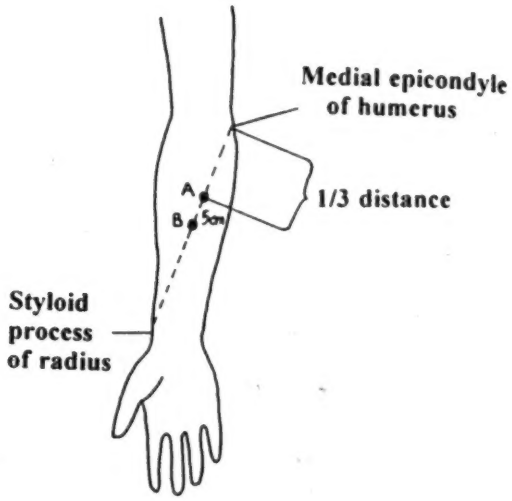
Skin temperature. Skin temperature in degrees Fahrenheit (°F) was measured using a J&J computerized, thermograph module model T-601. The temperature sensor was secured to the palmar surface of the distal phalange of the index finger with hypo-allergenic tape. General criteria used in interpreting skin temperature are that measures less than 85°F indicate sympathetic activation while those greater than 85°F reflect a relaxed state.

Pulse rate. Finally, a J&J computerized photoplethysmograph module P-401 was used to record pulse rate. The sensor was placed against the palmar pad of the thumb and secured with a velcro strip. Resting pulse rates greater than 80 beats per minute are generally considered elevated in adults. However considerable inter-individual variability is observed.

Event markers. The J&J physiological monitoring system permits markers to be inserted into the data file during data collection. These markers become a separate variable in the physiological data file to mark the occurrence of a significant event (for example, pain measurement or potentially pain-inducing procedure).

Figure 2

Placement of Skin Electrodes for Electromyography



Standard forearm flexor lead (Hugdahl, 1995)

Previous research has suggested that physiological readings may be affected by various environmental and individual specific factors. For example, readings may be affected by environmental factors such as room temperature, humidity, and time of day (Hugdahl, 1995; Opavsky et al., 1991; Rodger, 1995). Potential confounding factors specific to the individual include age, gender, race, and personality traits. To minimize the effect of these confounders, the period of data collection was relatively short, monitoring for each patient was conducted in one treatment area, and data were analysed at an individual rather than group level.

Glasgow Coma Scale

The Glasgow Coma Scale (GCS) was used as a screening tool for subject selection. It is perhaps the most frequently used tool for the rapid assessment of neurological status of acutely ill or severely injured patients (Cardonna et al., 1988). Using this scale, a patient's level of consciousness is evaluated based on three criteria: eye opening, verbalization, and movement. The patient's best response in each of these areas is assessed and scored. The maximum score for a fully awake and alert person is 15. A minimum score of three indicates a completely unresponsive patient. These scores are used

as predictors of functional outcome for patients who have experienced major neurological events (for example, cardiac arrest, head injury) (Hudak et al., 1998; Richmond, 1989).

Data Collection

Data were collected on patients for a period of four hours or until their discharge or transfer from the unit. With questions posed every 20 minutes, it was anticipated that approximately 12 pain measures per patient would be obtained. It was also assumed that during the period of data collection, changes would occur that would alter patients' interpretations of the magnitude and meaning of their pain. By collecting data using both a VAS and an acceptability criterion, a social validation approach was used to interpret what constitutes clinically meaningful pain scores. Physiological measurements were collected as objective interpretative criterion.

Ethical Considerations

Prior to the commencement of this study, the proposal was reviewed and approved by the Ethical Review Committees of the University and the Health Authority for the region in which the study was conducted (see Appendices A and B). All participants were assured of their right to confidentiality and that they could withdraw from the study at any time without explanation or repercussion. These principles were reinforced throughout the duration of patients' involvement in the study.

Because the experience of severe pain can have a distracting effect that could negatively affect patients' ability to make an informed decision, adjustments were made to the consent process. Prior to enrolment in the study, a verbal description of the project was given to potential subjects and their verbal assent to participate was obtained. If patients reported that their pain was at an acceptable level, they were asked to read and sign the consent form (Appendix C). Conversely, patients who reported that their pain was unacceptable were not asked to sign the consent form until their pain subsided to an acceptable level. In other words, only verbal assent to participate in the study was initially obtained from these patients. Once an acceptable level of pain was attained, these patients were given a consent form to read and sign. If at this time a patient decided to no longer participate in the study, data collection ceased and all data collected prior to this were destroyed. In addition, if the patient was accompanied by a family member, the patient was enrolled into the study only if the family member agreed.

Prior to the commencement of the study, the researcher met with the emergency staff (nursing and medical) to explain the purpose of the study. An information sheet was given to each nurse (full-time, part-time, and casual) employed in the unit (Appendix D). This sheet explained the purpose of the study, emphasized the confidentiality of all information given, and requested their cooperation during the study. During data collection if a nurse indicated that a particular patient should not be involved in the study,

this request was respected.

Pilot

The first person enrolled into the study was used as a pilot case to refine the protocol. Based on the information collected for this case, changes were made to the study protocol. These changes were necessitated by the number and acuity of patients treated in this trauma level one emergency department.

During the planning stages, it was recognized that a portable, physiological monitoring system was needed to accommodate the movement of patients within the emergency department. However to reduce costs, an attempt was made to convert a monitoring system previously acquired by the faculty into a portable unit by attaching a battery back-up unit. This equipment was arranged on a portable cart measuring 30 by 18 inches. Unfortunately, during the pilot it was determined that a much smaller cart was needed due to the limited space available in many of the treatment areas. Switching to a smaller cart (approximate size: height = 24 inches, width = 14 inches, depth = 14 inches) prevented the use of the battery back-up. Consequently, it was decided that physiological parameters would only be monitored when patients were in areas with a power outlet. Monitoring would be discontinued when patients went for diagnostic procedures, such as x-ray. To reduce the potential for intra-individual variations, skin electrodes were not removed during these interruptions.

This modification to the study protocol resulted in the addition of another restriction to the inclusion criteria. Patients would be approached to participate in the study only if they were triaged to treatment areas with access to a power outlet. This resulted in the exclusion of a number of patients from the study (for example, patients in the hallway).

Data Preparation and Analysis

Responses to Open-Ended Questions

The audio-taped interviews were transcribed by the researcher. Periodically, footnotes were added that contained additional details or insights about the nature and context of the actual interview process. The transcripts and audiotapes were compared by the researcher to ensure accuracy of transcription. Initially, each transcript was reviewed in its entirety to gain an appreciation of the subject's experience. Next, all the subjects' responses to the various questions were pooled and then analysed collectively. These responses were reviewed and compared to identify underlying themes. Gradually, responses were grouped based on their commonality. These groups were repeatedly delineated and defined until they became mutually-exclusive. Because the intent of the initial coding process was to examine the diversity of responses, no attempt was made to

limit the number of groups generated. Once this process was completed, the groups were sorted into larger, over-riding categories. Finally, labels were attached to these categories to reflect their overall theme. A second reader reviewed the transcripts and coding schema for five randomly selected cases to appraise how well the identified themes fit the data. No new or inappropriate themes were identified during this process.

Quantitative Data

All quantitative data were coded and entered into SPSS version 6.1 (SPSS Inc., Chicago, IL) (Norusis, 1993). Prior to entering patients' VAS pain scores into the data set, each score was measured twice by the researcher to ensure the accuracy of measurements. VAS scores were rounded to the nearest whole number. After all data had been entered into SPSS, a check for data entry errors was conducted.

Distributions were inspected, and descriptive statistics were obtained for all variables. Decisions regarding the use of parametric or nonparametric statistical tests were made based on the number of cases with relevant data, equality of groups when conducting comparative analyses, and the nature of the distribution of scores. An alpha value of $p < .05$ was used to indicate statistically significant findings. Due to the exploratory nature of this study, no adjustment was made to the alpha value despite the number of analyses conducted.

Graphical representations of each patients' pain ratings were created with time situated on the horizontal (X) axis and VAS pain scores on the vertical (Y) axis. A horizontal reference line indicating the patient's global rating (cut-point) for unacceptable pain was inserted on the graph. In addition, markers were inserted reflecting the patient's interpretation of the acceptability of each pain rating (that is, specific rating).

Physiological Data

The J&J physiological monitoring system generated a separate data file for each patient. The data for each patient were downloaded and converted into a SPSS data file. Physiological measures which were recorded every five seconds were collapsed by calculating the average for each one minute interval. Once this was done, it was possible to link these reading to the patient's pain ratings and other relevant information recorded in the field notes. This process was simplified by the event markers inserted into the physiological file during data collection. Visual inspection of the data was then conducted to determine whether the observed patterns reflected the postulated responses of the autonomic nervous system.

Chapter Four
- FINDINGS -

Missing Data

It has long been recognized that findings from laboratory studies may not translate into the realities of the clinical setting. However conducting research in active clinical areas poses several challenges. Due to high patient-flow patterns in the emergency department, it was not always possible to adhere to the established study protocol. This resulted in some loss of data. No attempt was made to replace missing values (for example, with mean or estimated scores) because no criteria were available to establish reasonable estimates. Analysis of each research question was conducted based on the number of subjects with available data. Data collected from 30 trauma patients were available for the analysis for the first and second research questions. Physiological measures for 15 patients were available for the analysis for research question three.

Overall Sample Characteristics

Sample Characteristics

A total of 33 patients were approached to participate in the study. Two men declined. One with facial burns refused stating that he was very uncomfortable. The other had been transferred from a medi-centre with abdominal injuries following a work-site injury. He stated his pain was not too bad at the moment, and that he really needed to go outside for a cigarette. As he left, he mentioned how frustrated he was becoming due to the waiting. He had waited at the medi-centre, waited to be seen by an emergency physician, and was now waiting for a specialist. The man who served as the pilot case was also not included in the final sample. Characteristics of the 30 subjects included in the study are presented in Table 3.

This sample reflects current trauma norms as the majority of subjects were young and male (National Center for Health Statistics, 1998; Statistics, Canada, 1998). The median age of the sample was 39.5 years (range 17 to 89). Men tended to be younger and more educated than women, although the difference was statistically significant only for level of education (Mann-Whitney U=74; Mean Rank 18.9 males and 9.6 for women, $p<.01$). Only one woman had post-secondary education compared to 10 (52.7%) men. Falls were the leading cause of trauma accounting for approximately one-quarter of the injuries. The falls experienced by three men involved elevation (for example, fell from ladder), while those experienced by the five women did not (for example, fell while walking). In trauma care, it is generally recognized that falls from an elevated height increase the potential for significant injury (Cardonna et al., 1988). Primary sites of injury were relatively evenly distributed among upper extremity, lower extremity, and the trunk. Approximately half (46.4%) of the patients were eventually diagnosed with soft tissue

Table 3
Characteristics for Total Sample and by Gender for Research Question One and Two

Characteristics	Males	Females	Total
Sample (n)	19 (63.3%)	11 (36.7%)	30 (100.0%)
Age (years)			
- Mean (sd)	36.7 (14.6)	52.9 (28.2)	42.6 (21.7)
- Median	39.0	48.0	39.5
Education			
- Elementary School	-	3 (27.3%)	3 (10.0%)
- Some High School	3 (15.8%)	4 (36.4%)	7 (23.3%)
- Completion Grade 12	6 (31.6%)	3 (27.3%)	9 (30.0%)
- College or Trade School Courses	2 (10.5%)	-	2 (6.7%)
- College or Trade School Diploma	4 (21.1%)	-	4 (13.3%)
- Some University Courses	1 (5.3%)	1 (9.1%)	2 (6.7%)
- University Degree	3 (15.8%)		3 (10.0%)
Mechanism of Injury			
- Fall (ground level)	-	5 (45.5%)	5 (16.6%)
- Fall (from elevation)	3 (15.8%)	-	3 (10.0%)
- Motor Vehicle Accident	3 (15.8%)	3 (27.3%)	6 (20.0%)
- Bicycle Accident	5 (26.3%)	1 (9.1%)	6 (20.0%)
- Sports	4 (21.1%)	1 (9.1%)	5 (16.6%)
- Crush Injury	3 (15.8%)	1 (9.1%)	4 (13.3%)
- Other	1 (5.3%)	-	1 (3.3%)
Primary Site of Injury			
- Hand, Wrist or Arm	3 (15.8%)	1 (9.1%)	4 (13.3%)
- Shoulder (including clavicle)	5 (26.4%)	-	5 (16.6%)
- Foot, Ankle or Leg	3 (15.8%)	3 (27.3%)	6 (20.0%)
- Hip (including femur)	2 (8.6%)	3 (27.3%)	5 (16.6%)
- Trunk (including spine)	5 (26.4%)	3 (27.3%)	8 (26.7%)
- Face	1 (5.3%)	1 (9.1%)	2 (6.7%)
Final Diagnosis			
- Fracture	6 (31.6%)	5 (45.5%)	11 (36.7%)
- Dislocation	2 (10.5%)	-	2 (6.7%)
- Fracture + Dislocation	2 (10.5%)	1 (9.1%)	3 (10.0%)
- Soft Tissue Injury	8 (42.1%)	5 (45.5%)	13 (43.3%)
- Amputation	1 (5.3%)	-	1 (3.3%)
This is "Worst" Pain Ever Experienced			
- Yes	8 (42.1%)	0 (0.0%)	8 (26.7%)
- No	11 (57.9%)	11 (100.0%)	22 (73.3%)
Disposition			
- Admitted to hospital	7 (36.8%)	6 (54.5%)	13 (43.3%)
- Discharged	12 (63.2%)	5 (45.5%)	17 (56.7%)

Note. Percentages may not equal 100.0 due to rounding

injuries (such as, whip-lash, lacerations, road abrasions, or muscle strains). Fractures and/or dislocations were diagnosed in the remainder. No gender differences were evident for type of injury.

Slightly more than half of the subjects were eventually discharged home (n=17, 56.7%). No statistically significant gender difference was observed in patient disposition (Fisher's Exact test = 1.0, nsd). Although follow-up was not an aspect of this study, two of the discharged patients were observed returning to the department with a primary complaint of persistent pain.

Question 1

How do stable, trauma patients interpret the severity of their pain and what causes it to change during their stay in the emergency department?

Data collected from 30 subjects were analysed for this research question. The purpose of this analysis was to investigate the magnitude of pain experienced by patients, and how it changed during their stay in the emergency department. Patients' perceptions of the factors that caused these changes were also examined.

Nature of Trauma Pain Experience

Pain was generally perceived as an unavoidable consequence of trauma. As one young man noted:

> *Yeah, it's acceptable considering it's a dislocated shoulder. It is not suppose to feel good.*
> (Male, Sports Injury)

Although all patients reported pain, one patient stated he only had pain with movement. Consequently, he scored each of his VAS measures as zero.

Two elderly women were unable to use the visual analogue scale even after repeated instruction. One of these women experienced difficulty using the VAS due to vision problems as she did not have her glasses. The other appeared to have difficulty concentrating on the measurement tool. This lady was very restless and frequently complained of intolerable pain. Neither of these women experienced problems reporting the intensity of their pain using an 11-point (0-10) numerical rating scale (NRS). Consequently, all analyses involving VAS pain ratings were done using data from 28 subjects.

A total of 210 pain intensity ratings were collected from the 28 patients. The median number of measures per patient was seven (range = 2 to 13). Initial VAS ratings of pain severity ranged from zero to 86 ($\overline{X}$ = 48.0, $\underline{sd}$ = 24.51, Median = 46.5) while the final

ratings ranged from zero to 83 ($\overline{X}$ = 31.1, sd = 27.28, Median = 21.5). The median difference between patients' initial and final pain ratings was 14.5, however these difference scores ranged from -55 (pain worsened during emergency stay) to 76 (severity of pain reduced) ($\overline{X}$ = 16.9, sd = 30.29, Median = 14.5). The mean pain level experienced by the patients during the period of data collection was 41.1 (sd = 21.87, Median = 40.4, Range = 0 to 80). Five patients (17.9%) experienced a worsening of their pain during their stay in the emergency department. No gender differences were observed in median difference scores between first and last pain measure, using the Mann-Whitney U statistical test (z = 0.30, NSD).

Twenty-two patients (73.3%) reported episodes of unacceptable pain during their stay. Three patients interpreted all their pain scores as unacceptable. Despite this, less than one quarter of the subjects (26.7%) interpreted this traumatic event as their worst pain experience. A variety of situations were identified as the source of "worst pain" including: previous injuries (for example, nerve damage, dislocations, crush injuries, stubbing toe), internal conditions (for example, gall or kidney stones, ovarian cyst, bowel obstruction, angina, migraines), medical or dental procedures (for example, removal of ingrown toenail, tooth extraction), and child-birth. Men were more likely than women to evaluate the current situation as their "worst pain" (Fisher's Exact test, p<.05) (Table 4).

Table 4

Number and Percent Who Interpreted this Experience as their "Worst Pain" by Gender

	Gender			
	Men	Women	Total	
"Worst Pain" Experience	n (%)	n (%)	n (%)	p-value
No	11 (57.9%)	11 (100.0%)	22 (73.3%)	.01
Yes	8 (42.1%)	0 (2.9%)	8 (26.7%)	
Total	19 (63.3%)	11 (36.7%)	30 (100.0%)	

Pain Management During Emergency Department Stay

Nine patients (30%; 7 men and 2 women) did not have analgesia prescribed or administered during their stay in the emergency department (Table 5). The highest pain intensity ratings reported by these nine patients ranged from zero to 98 (Median = 47). Anyone who had an analgesic prescribed had at least one dose administered. Morphine was the analgesic most commonly prescribed and intravenous was the most frequently used route of administration (see Table 5).

Table 5. Summary of Pain Management During ED Stay

	Total	Men	Women
Sample (n)	30	19	11
Analgesic Prescribed	21 (70.0%)	12 (63.2%)	9 (81.8%)
Analgesic Type			
- Morphine	6 (28.6%)	2 (16.7%)	4 (44.4%)
- Morphine + Fentanyl	4 (19.0%)	3 (25.0%)	1 (11.1%)
- Morphine + Robaxin	1 (4.8%)	1 (8.3%)	-
- Fentanyl	2 (9.5%)	1 (8.3%)	1 (11.1%)
- Toradol	2 (9.5%)	1 (8.3%)	1 (11.1%)
- Meperidine (Demerol)	4*(19.0%)	3 (25.0%)	1 (11.1%)
- Demerol + Fentanyl	1 (4.8%)	1 (8.3%)	-
- Dilaudid	1 (4.8%)	-	1 (11.1%)
Analgesic Route			
- Intravenous (IV)	10 (47.6%)	4 (33.3%)	6 (66.7%)
- Intramuscular (IM)	6 (28.6%)	4 (33.3%)	2 (22.2%)
- IV or IM	3 (14.3%)	3 (25.0%)	-
- Orally	1 (4.8%)	-	1 (11.1%)
- Orally +IV	1 (4.8%)	1 (8.3%)	-

Note. Percentages may not equal 100.0 due to rounding

* One woman refused morphine due to previous hallucinogenic reaction.

Factors Affecting Change in Pain Ratings

Even though the period of data collection was relatively short, patients frequently reported a change between consecutive pain measures. Of the 182 pain comparisons, 119 (65.4%) reflected a change in pain severity. Approximately one-quarter (n=44) of these reflected a worsening of pain since the last measure. The magnitude of change between two consecutive pain measures ranged from -35 (worsening of pain since last measure) to 51 (a reduction in pain).

The unpredictability of this change was a source of concern and anxiety for some patients. Two men commented:

You don't know when it [pain] is going to start to climb. (Male, Crush Injury)

No, it's starting to slowly, gradually, all the time, hurt again. It's still bearable right now, but I can feel it coming back. (Male, Fall)

Patients attributed changes in their pain experience to a variety of precipitating factors. Responses to the question "what caused your pain to change" were categorized into two main categories: (1) self-induced, and (2) other-induced (factors affected by actions of

others) (Table 6). Self-induced factors were further sub-divided into psychological and physical-behavioural factors.

Pain aggravating factors. Responses were separated into those associated with an increase in pain intensity (n=102 responses) and those associated with a reduction (n=79 responses). The three most frequently reported factors affecting an increase in pain were: (1) assessment or diagnostic measures such as positioning for X-rays (n=22, 21.6% of responses), (2) movement of injured area by the patient either purposefully (for example, changing position) or involuntarily (for example, spasm or tremor) (n=17, 16.7%), and (3) side effects of treatments and medications such as the discomfort resulting from spinal precautions (n=15, 14.7%).

Many patients expressed a sense of fear or dread about the movement or manipulation of the injured area that occurred as a result of diagnostic and treatment measures.

> *All that moving [in x-ray department] just really got it going. And now, I can't get it back where it doesn't hurt. I hope, I don't have to have more.* (Male, Bike Accident)

Spinal precautions (e.g., back boards, cervical collars) were a common aggravating factor. In fact, every patient (n=10) treated with these devices complained of the discomfort they caused. The frequency and intensity of these complaints increased with the duration of their application. Not only did the application of spinal precautions aggravate patients' pain experience, it also evoked fears of possible paralysis or long-term disability.

> *The worst pain that I have is my head lying on the back of this [cervical] collar. It is causing steady, sharp, agonizing, annoying pain that just won't go away.*
> (Male, Bike Accident)

> *When they first brought me in, I was out of it almost. I was in so much pain. I was so (pause) and the paramedics kept telling me to relax. I couldn't. I was so sore. It was scary. And so I was really tense. But the more I started to tense up, the more it started to (pause) I couldn't tolerate it. In a way, it doesn't make sense. I came in with all this big, heavy duty equipment, and now I'm leaving.* (Female, Sports Injury)

As might be anticipated, the removal of these devices precipitated a dramatic and almost instantaneous reduction in patients' pain.

> *It is still really sore, but it is more liveable since this thing [spinal restraint] has come off. It is better.* (Female, Sports Injury)

Pain reduction. The administration of medications was most frequently identified as a factor resulting in the relief of pain. One-quarter of the responses pertaining to pain reduction dealt with drug administration (n=20, 25.3% of responses).

Table 6. Themes for Responses to "*What Has Caused Change*" in Pain

Self-Induced		Other-Induced
Psychological Factors	**Physical-behavioral Factors**	**Situational Factors**
• ***Perceived ability to control/alter situation***	• ***Purposeful movement injured area by patient*** - Shifting of body position - Getting onto stretcher	• ***Assessment/Diagnostic Measures*** - Manipulation of injured part - Removal of dressings or splints - Positioning for X-rays - Exposure of wound to air
• ***Implementing coping strategies*** - Self-talking (e.g., telling self "it's okay") - Relaxing - Distracting (e.g., talking to others, thinking about other things) - Smoking a cigarette (versus unable to)	• ***Involuntaruy movement injured area*** - Muscle tremors or spasms	• ***Treatment of Injuries*** - Care of wounds (cleansing or suturing) - Applications of traction, splints, dressings - Reduction of dislocation
• ***Attaching meaning to situation*** - Issues such as: - *"What's happening?"* - *"Is damage permanent?"* - *"How will I manage if discharged?"* - *"Will "unacceptable" pain return?"*	• ***Immobility of injured area by patient*** - Splinting of injured area - Not moving	• ***Adminstration of Medications*** - Analgesic agents - NSAIDS, Entonox, Opioids - Anxiolytics - Anaesthetic agents - Local Anaesthetics, Conscious Sedation
• ***Understanding injury and probable outcome***	• ***Degree of inflammation (swelling)***	• ***Side Effects of Treatments/Medications*** - "Hardness" of spinal board - "Pressure points" of cervical collar - Enforced immobility caused by spinal precautions - Nausea from medications - Burning of local anaesthetic agents
• ***Attention-demanding nature of pain*** - Initial Shock (Numbness) Wearing Off - Getting tired of pain - Getting use to pain - Ignoring pain	• ***Fatigue***	• ***Effects of Medications Wearing Off***
	• ***Thirst***	• ***Waiting (for)*** - Availability of treatment area - Assessment and treatment by ED staff - Arrival of consultants (e.g., orthopaedics)
	• ***Nausea***	• ***Comfort Measures Offered*** - Physical presence of others - Holding hand - Provision of information /reassurance
	• ***Pre-existing Medical Conditions*** - e.g., Arthritis, Chronic Pain	

It is just really annoying. It is frustrating being in pain, and not being able to do anything about it. When it is not bearable, it is just because I need more help with the drugs. When it is bearable, it is just because of the drugs.

(Female, Motor Vehicle Injury)

Well, that stuff [Fentanyl] was perfect. It just took like under a minute and I could feel it just going through my head, and seeping down through. And you just felt like going to sleep. It was nice. It took your mind off the pain.

(Male, Sports Injury)

The value of non-pharmacological measures in the reduction of pain was also identified. Patients' reported the use of coping strategies such as distraction, positive self-talk, and relaxation (n=17, 21.5% of responses). Patients also valued the comfort and supportive measures offered by others (n=12, 15.2%). They acknowledged the support received from family members, health care professionals, and even the data collector.

That may be attributed to having someone in here to talk to cause then you don't think about it as much. I was finding it real uncomfortable when I was sitting in here before because then all you're doing is thinking about how bad this thing is hurting.

(Male, Fall)

Several patients also acknowledged the initial support they received from onlookers at the scene of the injury.

It is nice to have someone to talk to, especially when it happened. I was lucky that there was some good people there that for one thing held your hand, and talked to you.

(Male, Crush Injury)

Question 2

What do stable, trauma patients interpret as acceptable pain severity?

The purpose of this analysis was to examine how patients interpret the acceptability of their pain experience. Data collected from 28 subjects were analysed for this research question. As previously mentioned, two elderly women were not able to use the VAS.

Ratings of Pain Acceptability

Patients were asked to interpret the meaning of their pain by indicating its acceptability or unacceptability. Specific ratings of acceptability were obtained concurrently with each VAS pain score. During the last measurement, patients also gave a global (that is, general) VAS rating representing the cut-point between acceptable and unacceptable trauma pain.

Of the 210 pain scores, 204 (97.1%) could be evaluated in terms of agreement between patients' specific and global ratings of acceptability. Six scores were not included as they were classified as borderline cases. These scores either fell on the reference line for the global cut-point, or the patient expressed ambivalence when assigning the specific rating. Points that fell on the line were excluded due to coding difficulties. Because the line signified the cutpoint between acceptable and unacceptable pain, scores that fell directly on the line could not be coded as one or the other. Using patients' specific ratings of the acceptability of their pain, 36.3% of the pain scores were interpreted as unacceptable. This percentage dropped slightly to 31.4% when patients' global ratings of acceptability were used.

Agreement between specific and global acceptability ratings of pain scores was observed in 88.7 percent of the measures (Table 7). A kappa coefficient was calculated to correct for chance agreement. This resulted in a kappa of .75. A kappa of this size suggests substantial agreement between the two ratings (Pett, 1997; Sackett, Haynes, Guyatt, & Tugwell, 1991).

Table 7

Agreement between Patients' Specific and Global Ratings of Acceptable and Unacceptable Pain

	GLOBAL Rating		
SPECIFIC Rating	**Acceptable Pain**	**Unacceptable Pain**	**TOTAL**
Acceptable Pain	124	7	131
Unacceptable Pain	16	57	73
TOTAL	140	64	204

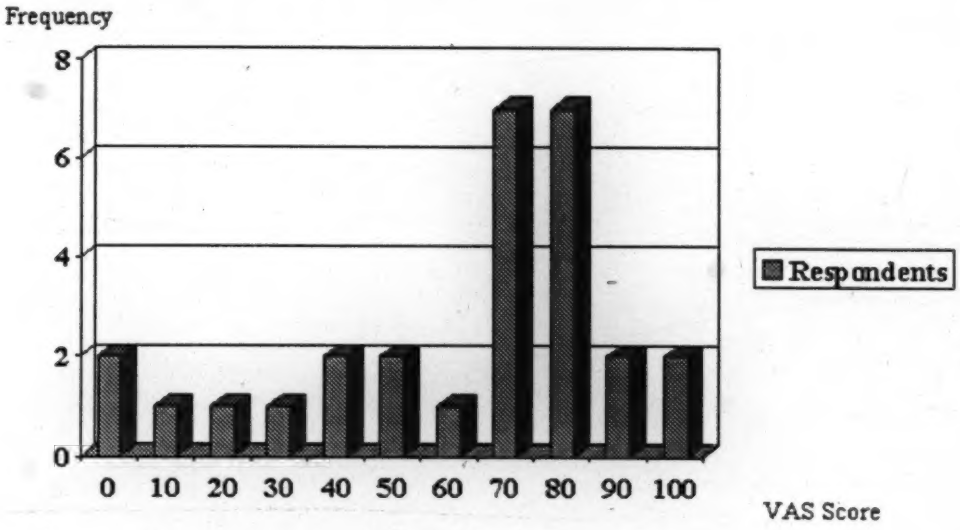
Percent of agreement = 88.7%

Kappa = $\frac{\text{Actual agreement beyond chance}}{\text{Potential agreement beyond chance}}$ = .75 ($p<.05$)

Of the 23 pain scores in which disagreement was observed between patients' specific and global ratings of acceptability, 69.6 percent (n=16) involved pain scores interpreted as unacceptable at the time (specific rating) but acceptable in terms of the patients' global (general) rating. Sixty-five percent (n=15) of the disagreements were obtained from four subjects. Two of these patients were elderly women, both in their eighties, who experienced fractures. The other two subjects whose ratings of acceptability exhibited a consistent lack of agreement were young men. The remaining disagreements involved eight different patients (one error per subject). Due to the high level of agreement between the two ratings of acceptability, a decision was made to use global ratings for all subsequent analysis.

Figure 3.

VAS Cut-point between Acceptable and Unacceptable Pain



Global ratings of unacceptable pain. The variability in the intensity of pain that patients interpreted to be unacceptable is illustrated by Figure 3. Scores for the VAS cut-point between acceptable and unacceptable pain ranged from zero to 100. The median score was 72.5. No significant gender difference was observed in the median cut-point between acceptable and unacceptable pain (using Mann-Whitney U test) (Men: $\overline{X} = 60.1$, $sd = 28.44$, $Md = 73.0$; Women: $\overline{X} = 62.6$, $sd = 28.78$, $Md = 72.0$). In addition, no significant relationship was observed between patients' global cut-point and their age or level of education (using Spearman's rho) (Pett, 1997).

Two patients (one man and one woman) indicated that they would interpret any pain as unacceptable. One stated that no pain was acceptable as she didn't know why she was having it. The other simply stated that no one wants to experience pain. In sharp contrast, two men chose the opposite extreme of the VAS indicating that pain intensity of 100 was acceptable following trauma.

Characteristics of Unacceptable Pain

Approximately 200 descriptors were generated for unacceptable pain. These descriptors were categorized into two main headings: (1) reactive (how person responds to pain either psychologically or physically), and (2) sensory (qualitative characteristics of the pain). The adjectives presented in Table 8 as well as the following exemplars clearly illustrate the aversive nature of unacceptable trauma pain.

> *Well, if you are rating this on a scale of 0 to 10, I'm going to say that if it got to 10 that would be intolerable, and then I would be wanting something. When it got to a 10 then it probably peaked where I wasn't going to deal with it or didn't want to deal with it anymore. And then it would be nice to do something about it.* (Male, Crush Injury)

> *I would say it is unacceptable if it is to the point where that is all my mind is currently thinking about, and nothing else. Even though it is sore right now, I can hold a conversation and talk about other things. It hurts but it is not the only thing in my mind. But when it is just that intense, and my palms start to sweat and my body starts to sweat and I get the shakes, that pain is unacceptable to my body.* (Male, Sports Injury)

Factors influencing unacceptable pain. Although a specific question was not asked about what factors influenced patients' interpretations, patients spontaneously offered such factors as they attempted to define unacceptable pain. All patients identified at least one qualifier (total responses = 93) (Table 9). These qualifiers were categorized into three main groups: characteristics of the individual, perception of the pain-producing event, and situational factors. Patients' responses about the factors affecting their interpretations were relatively evenly distributed among the three categories (Table 10).

Patients interpretations of the meaning and acceptability of their pain experiences were influenced not only by characteristics specific to the individual and the type of injury, but also to situational factors such as the business of the department and activity required.

> *Well, you know if they are busy and what not, I wouldn't call for it. Because they get busy with so many other things. I wouldn't call for it. I'm not one for pain killers.* (Female, Fall)

> *Well, it is acceptable as long as I'm laying. But if I was up I couldn't accept it at all. I couldn't do anything if I was up.* (Female, Crush Injury)

Duration of the pain experience was another important situational qualifier in the interpretation of unacceptable pain. Many patients appeared to impose a time limit for the acceptability of their pain.

> *I wouldn't want to live like this. Yeah, it is tolerable, right now. But it is still sore, don't get me wrong, it hurts.* (Male, Sports Injury)

Table 8. Attributes of Unacceptable Pain

Reactive - Psychological	Reactive - Physical	Sensory
• ***All-consuming*** - Mind-grabbing, Can't Ignore It • ***Can't Think Straight*** - Don't know what to do • ***Can't deal with it (or don't want to)*** - Want something to ease it - Don't care what done just get rid of it • ***Unexplainable*** - "not normal" • ***Signifies negative consequences*** - Serious physical damage - Body won't heal • ***Uncontrollable*** - Hurts regardless of what I do • ***Intolerable*** • ***Unbearable*** • ***Unliveable*** - Can't live like this - Wish you were dead • ***Excruciating*** • ***Tedious*** - Get sick of it - Gets on your nerves • ***Upsetting*** - Can't relax, Hard to stay calm - Make you want to cry • ***Unpleasant*** - Makes you unhappy - Doesn't feel good - "Sucks", "Weird" - "Bad", "Not cool" • ***Agonizing*** • ***Annoying*** - Irritating, Frustrating • ***Terrifying*** - Panicky, Frightening - Scary	• ***Nauseating*** • ***Body and palms sweat*** • ***Everything aches*** • ***Involuntary body movements*** - Shakes - Wincing - Spasms • ***Tense*** • ***Tiring*** • ***Makes you "a little woozy"*** • ***Vocalizations:*** - Moaning, Groaning - Whining - Scream - Cry Out • ***Immobilizing:*** - Can just sit there - Can't do anything - Don't want to do anything - Can't move - Crippling • ***Can't Get Comfortable*** - Restless - Can't rest/sleep - Can't relax • ***Can't Converse/Talk*** • ***Can't Laugh***	• ***Constant*** - Steady - Won't go away - Static - Continuous - No Breaks • ***Long duration*** • ***Intense*** - Extreme - Incredible - Strong - Severe - Major - Massive - Terrible - Harsh • ***Quality*** - Sharp - Burning - Biting - Shooting - Throbbing - Ripping, Tearing - Stretched to the "Max" - Stabbing - Just plain sore - Pounding - Pressure - Big Weight - Sensitive • ***Growing*** - Spreading - Radiating

Table 9. Factors Influencing Interpretation of Unacceptable Pain

Characteristics of Individual	Perceptions of Noxious-Producing Event (Trauma)	Situational
• ***Past Experience with Pain*** - "I've nothing to compare it to." - "I've never experienced 'worst pain possible'." - "This isn't as bad as when I broke my shoulder." - "This is new, I've never felt like this." • ***Perceptions of Equity (Accept Fair Share)*** - "I've been lucky up to now so I shouldn't complain." - "I've been healthy so a little pain is alright." • ***Perceived Pain Thresholds*** - "I'd have to be desperate to ask for help." - "I hurt myself a lot at work. Hit myself with the hammer and that kind of thing. I get use to it so maybe I have a high pain tolerance." • ***Personal Needs*** - "I have to get out of here. I've horses to break." - "If I had to play a game of football, I could but I'm glad I don't have to." - "People build up a tolerance for acceptable pain based on their needs." • ***Status Prior to Injury*** - "It's worse cause I'm tired. I've been up all day." • ***Attitudes About Pain & Use of Analgesics*** - "Don't really like using drugs if I don't have to." - "My attitude is pain is warning me that I've been injured."	• ***Causative Factor (Source of Pain)*** - "It's only to be expected, I've been injured." - "It's a dislocated shoulder. It's not suppose to feel good." - "Any pain that you don't know why it's happening is unacceptable." - "It's relative. It depends on the circumstances". - "Different injuries would have different thresholds of pain." • ***Responsibility for Injury*** - "I was stopped [red light]. She just ran into me." - "He must have been travelling 500mph." - "I must pay for being there." - "I wish someone had told me an hour ago not to be such an idiot." • ***Perceptions of Possible Outcomes*** - "I'm lucky to be alive" - "Do whatever necessary, don't want to lose finger." • ***Anxiety or Fears Evoked*** - "I was so scared ... It doesn't make any sense. I came in with all this big, heavy equipment and now I'm going home." - "You don't know when it [pain] is going to start to climb again." - "I don't want it to get back to where it was" • ***Self-Monitoring of Changes in Pain Status*** - "It's nothing to what it was a half an hour ago." - "Compared to what it was, it's acceptable"	• ***Time Elapsed*** - "Can grin & bear it if only short spurts." - "Waiting always sucks." - "Okay for now, but I wouldn't want to live like this." - "I will be glad when this is over. " • ***Activity Level in Department*** - "These people are busy. I wouldn't ask them for anything." - "Must bide my time till they deal with it." - "I know there are people here in worse shape." • ***Extraneous Factors*** - "This [spinal] board is so uncomfortable." - "More liveable since this thing [collar] is off." - "If there is more comfort that helps the pain." • ***Presence of Others*** - "It helps to have someone to talk to. It takes your mind off of it [pain]". - "It helped. I just wanted to see them [parents]." • ***Activity Level*** - "It's acceptable as long as I'm laying here, but if I was up I couldn't accept it at all." - "Right now it's okay, but I will need something if I'm to sleep." • ***Perceived Options*** - "I can't do anything about it." - "I've no choice but to put up with it."

I suppose if it is sitting around an 8 [on an 11-point numerical rating scale] and you waited a long time to have something done, it might get a little tedious after a while, and you'd want to have someone come and say "look it's going on two or three hours let's do something about it". So long term on a lesser scale I'd probably ask you to do something.
(Male, Crush Injury)

If the pain only lasted for a few seconds, I would be able to handle more. But for the length it was there, that's where you don't really want to go through it too long.
(Male, Sports Injury)

Patients also considered the nature of the pain-producing event (trauma) as well as their role in its occurrence when interpreting the acceptability of their pain.

Acceptance is really a relative term depending on the circumstance that you are in because when you think what could have happened. (Male, Motor Vehicle Injury)

I wasn't doing anything. I was just sitting there, and she ran into me. So no, it [pain] is not acceptable.
(Female, Motor Vehicle Injury)

Finally, patients' past experience with pain was the most commonly identified individual-specific characteristic used when interpreting the acceptability of their pain.

I hurt myself a lot, at work. I hit myself with the hammer and that kind of thing, and I just kind of get use to it so. Perhaps I have a high pain tolerance because generally when I injure myself, I just stop and think about it for a couple of seconds and then just carry on.
(Male, Bicycle Accident)

Considering that I've broke a bone, I guess so. I've never broke a bone before so I don't know what to compare it to.
(Male, Bicycle Accident)

Table 10. Number and Percent of Factors Influencing Interpretations of Unacceptable Pain

Categories	Number of Responses (Percent)
Situational - Time Elapsed (n=13) - Activity Level (n=9)	34 (36.6%)
Perceptions of Pain Producing Event - Monitoring This Pain Experience (n=10) - Anxiety or Fears Evoked (n=7)	32 (34.4%)
Characteristics of Individual - Past Pain Experiences (n=12) - Perceived Pain Tolerance (n=6)	27 (29.0%)
TOTAL	93 (100.0%)

Graphic Representations of Trauma Patients' Pain Experience

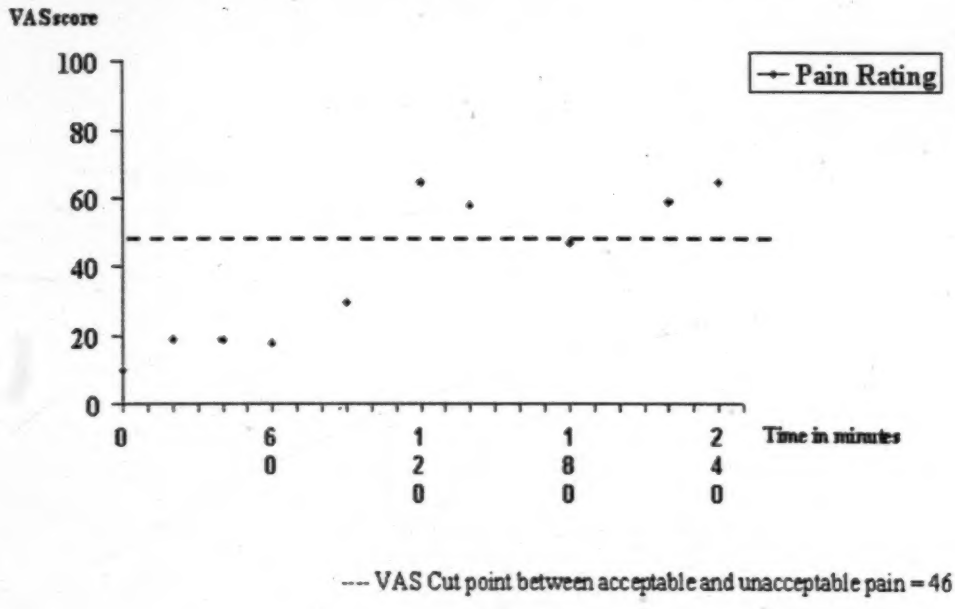
Figure 4 depicts the pain scores reported by a 67 year old man diagnosed with a fractured femur following a bicycle accident. During his emergency stay, this patient received a total of 15 milligrams of morphine intravenously in incremental doses. However as evidenced by the following statement, his pain became increasingly unacceptable despite the analgesics administered.

> *It's really all-consuming right now . . . . It's bothering me. It's continuous and sharp, and I can't find anyway I can move. I will be glad when this is over. . . . It is tearing right through to my lower back now.*

After spending approximately four and a half hours in the emergency department, this patient was transported to the Operating Room with an unacceptable level of pain.

Figure 4

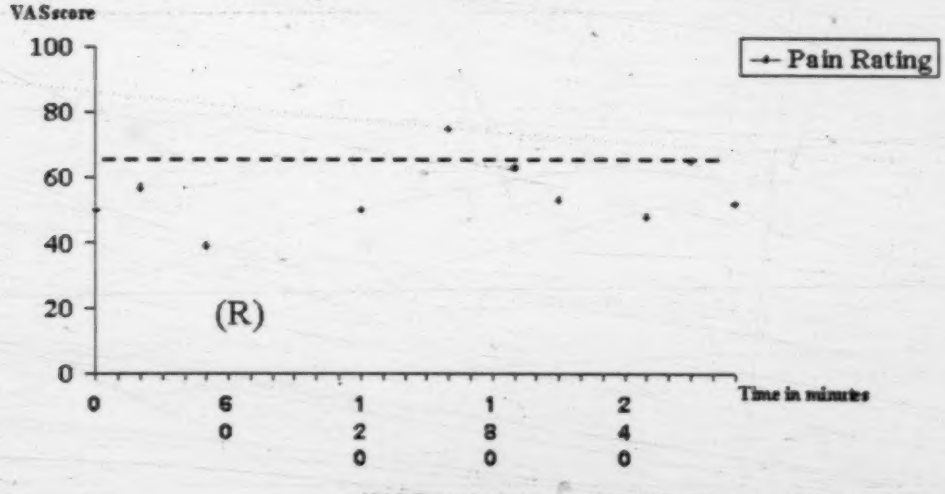
Pain experience of a 67 year old male with a fractured femur



Figures 5 and 6 depict the pain scores of two young men - both were less than thirty years of age, diagnosed with a fracture-dislocation of the tibia and fibula requiring closed reduction in the emergency department, admitted to hospital for further treatment, and prescribed morphine 2.5mg intravenously prn (pro re nata). Both received a total of 32.5 morphine-equivalent milligrams of analgesia in intermittent intravenous doses during their stay in the department. Despite the similarities in these cases, dramatic differences are evident in their pain scores. The man depicted in Figure 5 was admitted on an extremely busy night in the department. He was moved to the hallway less than an hour following the closed reduction of his dislocated extremity. Seven different nurses were involved in the assessment and management of his pain. Conversely, patient volumes were unusually low during the treatment of the man depicted in Figure 6. A nurse accompanied the patient to the x-ray department for the specific purpose of administering additional analgesic if needed. However in spite of this care, approximately one hour elapsed from the time the patient was enrolled in the study until pain intensity scores of less than 30 were achieved.

Figure 5

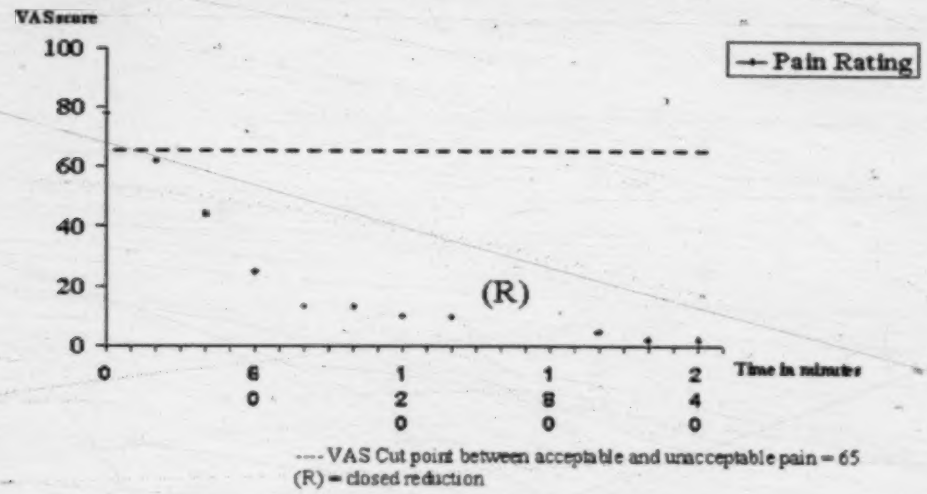
Pain Experience of a 26 year old male with a fracture-dislocation of tibia-fibula



---VAS Cut point between acceptable and unacceptable pain = 67
(R) = closed reduction

Figure 6

Pain Experience of a 17 year old male with fracture-dislocation of tibia-fibula



---- VAS Cut point between acceptable and unacceptable pain = 65
(R) = closed reduction

Question 3

Is An Association Evident between Patients' Pain Interpretations and their Physiological Responses?

Sample Characteristics

Data for 15 patients (six men and nine women) were available for the analysis of this question. To be included in this analysis, it was necessary for physiological data plus pain ratings to have been collected during the same time period. In addition, variation was needed in the patient's ratings of acceptability (i.e., mixture of acceptable and unacceptable ratings). Physiological measures were linked to the patient's global ratings of acceptability rather than to the VAS scores due to the lack of established criteria for interpreting these scores and the degree of variability observed in patients' interpretations of acceptable pain.

Reasons for not including the remaining 15 patients in this analysis were: (a) two patients were excluded due to technical problems with the storage or retrieval of physiological data, (b) six patients interpreted all their pain scores as acceptable, (c) three patients always interpreted their pain as unacceptable, and (d) four patients had insufficient

physiological data due to their relocation to treatment areas without power access.

A description of the 15 patients included in the analysis for question 3 is presented in Table 11. Similar patterns were evident for men and women in terms of type of injury and disposition. Once again, the men tended to be younger than the women.

Table 11

Sample Characteristics for Research Question Three

Case	Age (years)	Mechanism of Injury	Diagnosis	Disposition
A) Men				
1	49	Motor Vehicle Injury	Soft tissue injuries	Discharged
2	29	Sports Injury	Dislocation	Discharged
3	18	Sports Injury	Fracture	Admitted
4	43	Fall	Fracture	Admitted
5	26	Bicycle Injury	Soft tissue injuries	Discharged
6	52	Motor Vehicle Injury	Soft tissue injuries	Admitted
B) Women				
7	89	Fall	Fracture	Admitted
8	77	Crush Injury	Soft tissue injuries	Discharged
9	37	Bicycle Injury	Soft tissue injuries	Discharged
10	25	Motor Vehicle Injury	Soft tissue injuries	Admitted
11	17	Sports Injury	Soft tissue injuries	Discharged
12	48	Fall	Fracture-Dislocation	Admitted
13	22	Motor Vehicle Injury	Fracture	Admitted
14	81	Fall	Fracture	Discharged
15	78	Fall	Fracture	Admitted

Pain Scores

A total of 81 pain scores were linked to physiological readings. The number of linked pain-physiological measures available per patient ranged from three to eight. Thirty-three (40.7%) of the pain ratings were interpreted by the patients as unacceptable.

Situations in which congruency was noted between the postulated and observed changes in patients' physiological responses during periods of acceptable and unacceptable pain are presented in Table 12. Inspection of these data reveals that there is no identifiable pattern or trends evident in patients' physiological measures of skin temperature, pulse, or electrodermal activity. Only EMG readings were observed to follow the postulated changes, and even then only with the male patients. Congruence was observed between the postulated and observed responses for the men's EMG activity in each of the six cases (see Table 12, Panel B). No congruence was consistently observed between the postulated and observed responses for any of the physiological measures in the women. The actual EMG readings for each of the 15 patients are presented in Appendix E.

Table 12

Congruity between Postulated Changes and Observed Changes in Physiological Responses during Periods of Acceptable and Unacceptable Pain

A) Postulated Changes

Physiological Response	Postulated Response to Unacceptable Pain
Electromyogram (EMG)	Increased scores
Skin temperature (Temp)	Decreased scores
Electrodermal activity (EDA)	Increased scores
Pulse rate (Pulse)	Increased scores

B) Congruity Between Observed and Postulated Changes

Case	Number Comparisons of Pain Interpretation + Physiological Measure (No. Interpreted as Acceptable)	EMG	Temp	EDA	Pulse
A) Men					
1	3 (2 acceptable)	Yes	-	Yes	-
2	4 (2 acceptable)	Yes	-	-	-
3	5 (1 acceptable)	Yes	Yes	-	-
4	8 (7 acceptable)	Yes	-	-	Yes
5	3 (1 acceptable)	Yes	-	Yes	Yes
6	5 (2 acceptable)	Yes	-	-	-
B) Women					
7	7 (2 acceptable)	-	-	-	-
8	7 (4 acceptable)	-	-	-	Yes
9	6 (5 acceptable)	Yes	-	-	Yes
10	3 (2 acceptable)	-	-	-	-
11	4 (3 acceptable)	-	Yes	-	-
12	6 (4 acceptable)	-	-	-	-
13	6 (5 acceptable)	-	-	-	-
14	7 (6 acceptable)	-	-	Yes	-
15	7 (2 acceptable)	-	-	-	-

Note. - indicates a lack of congruity between postulated and observed changes in physiological responses.

Chapter 5
- DISCUSSION -

It has been suggested that pain and its measurement should be viewed as the fifth vital sign - in conjunction with the patient's temperature, pulse, respirations, and blood pressure (Kantor, 1999; McCaffery & Pasero, 1997; Torma, 1999). However pain measurement may not warrant such recognition as current tools have not attained the level of clinical utility achieved by traditional vital signs. In this chapter, conceptual issues associated with the measurement of acute pain are discussed as well as methodological issues associated with the conduct of research in an active clinical environment such as the emergency department.

Conceptual Issues

Pain and Its Measurement

To have clinical utility, scores on pain measurement tools must be trustworthy, accurate and meaningful. Because pain is conceptualized as a subjective phenomenon, verbal measures have been labelled the "gold standard" for pain measurement (Acute Pain Management Guideline Panel, 1992). It is generally accepted that self-reported pain scores provide a trustworthy and accurate representation of patients' perceptions of their experience. However for pain scores to be clinically meaningful, a common understanding is needed in terms of the significance of particular scores on these tools, and what scores warrant intervention. Currently, there is no common understanding of the meaning of scores on pain measurement tools.

Three questions regarding the meaning of pain scores were posed in Chapter Two. These questions were: (1) do all patients who score pain intensity less than 30 on a VAS have acceptable pain control? (2) should pain scores be interpreted based on patients' reports of acceptability? and (3) should pain scores be interpreted differently depending on the situation or type of pain? Although these questions differ from those addressed in this study, they address specific issues pertaining to the interpretation of pain scores. Answers are offered for each of these questions based on the findings of this study.

Pain intensity and the significance of a VAS score of "30". The variability in patients' interpretations of what constitutes an acceptable level of trauma pain suggests that patients had no common understanding of the meaning of VAS scores. In particular, the value of 30 had no special meaning or significance for patients. Only three patients (10.7%) indicated a cut-point for differentiating acceptable and unacceptable pain within ± 10 units of 30. Although four (14.3%) patients set their cut-point for acceptable trauma pain below 30, the majority perceived much higher intensities of pain as acceptable as evidenced by the median VAS score of 72.5. Half (n=14) of the patients in this study not only set their global ratings of acceptability at a value greater than 30, they also

experienced an average pain severity greater than 30. These findings suggest that more work is needed before a cut-point can be established that meaningfully separates acceptable and unacceptable pain.

Using patients' acceptance to interpret pain severity scores. Patients' responses regarding the attributes of unacceptable pain were sorted into two categories: sensory and reactive. Patients' responses describing the sensory attributes of unacceptable pain pertained to its consistency, intensity, duration, and unpleasant nature. Responses describing the reactive attributes of unacceptable pain were further subdivided into psychological and physical characteristics. Some of the physical signs and symptoms of unacceptable pain reflected autonomic nervous system activation (for example, perspiration, nausea, thirst, spasms, and tremors), while other physical characteristics exemplified the immobilizing and discomforting effects of unacceptable pain. Psychological characteristics reported by patients depicted their feelings of inability to cope with the experience, loss of control, and fear of the unknown or of the potential for negative outcomes. Overall, these descriptors provide a vivid portrayal of the multi-dimensional and negative nature of unacceptable pain.

The degree of agreement observed between patients' specific and global ratings of the acceptability of their pain suggests some consistency or stability in the interpretative criteria used by patients, at least during their initial treatment in the emergency department. Out of 204 comparative ratings, disagreement between patients' specific and global ratings of acceptability occurred in only eleven percent of cases. In the majority of these cases, patients' specific ratings of acceptability were lower than their global ratings. Approximately three-quarters of these errors involved four patients - two elderly women and two young men. Positioning of the VAS line may have been a contributing factor for one woman as she was lying in a supine position. Wewer and Lowe (1990) have suggested that the angle at which subjects view the VAS line may introduce measurement bias. Fatigue or the duration of the pain experience may have affected how the other woman interpreted the acceptability of her pain as she waited several hours for treatment. Although her ratings of pain intensity remained relatively constant in that eight of her 11 pain scores were 73, she eventually interpreted this intensity of pain as unacceptable. However based on her global rating of acceptability, this intensity of pain was considered acceptable. Duration of the pain experience may therefore be a critical factor in interpreting its acceptability. The disagreement observed between the specific and global ratings of acceptability reported by two young men may be related to their anxiety. Throughout their emergency stay, both men expressed concerns about the consequences of their injuries; the one in terms of the potential re-occurrence of severe pain, the other in terms of the potential for permanent physical damage.

An examination of the patients' ratings of sensory (i.e., severity) and interpretative (i.e., acceptability) pain revealed four general patterns of response. These patterns were: (1) high severity, unacceptable pain, (2) low severity, acceptable pain, (3) low severity,

unacceptable pain and (4) high severity, acceptable pain. Currently, the pain literature focuses predominantly on two of these patterns - high severity, unacceptable pain and low severity, acceptable pain. Guidelines for pain management generally recommend that interventions be initiated for patients exhibiting the high severity, unacceptable pain pattern, while the low severity, acceptable pain pattern is depicted as a goal of treatment. Little attention has been given to the patterns of high severity, acceptable pain and low severity, unacceptable pain, even though they may pose significant challenges for effective pain management. For example, patients exhibiting the high severity, acceptable pain pattern of response may not initiate actions aimed at pain relief even when experiencing severe pain. This situation may be further complicated if clinicians wait for patients to request analgesia or assess pain by simply asking patients "is your pain okay?" This pattern of response may partially explain why researchers have observed that some patients express high levels of satisfaction with their care despite the experience of moderate to severe pain (Donovan, 1983; Lavies, Hart, Rounsefell, & Runciman, 1992; Ward & Gordon, 1994). If patients expect and are willing to accept high levels of pain, they are unlikely to be dissatisfied when they experience it. Patients who exhibit this pattern of pain response are at increased risk for the negative immediate and long-term consequences of unrelieved pain. Pain management may be equally problematic with patients who indicate that even a low level of pain is unacceptable. It is unlikely that all of the pain evoked by a traumatic injury can be eliminated during the initial emergency treatment period. Patients exhibiting this low severity, low acceptability response need to be informed that their expectations for pain relief may be unrealistic and unachievable at this time. Both patterns of response indicate the need for collaborative interactions between the health care professional and the patient to establish realistic and attainable treatment goals.

Based on the findings of this study, patient's acceptance may not be an appropriate criterion for interpreting trauma pain. Other interpretative criteria for evaluating the adequacy of pain intensity need to be identified and tested. Findings also suggest that different interpretative criteria may be required for different clinical situations. Even within the emergency department, different interpretative criteria may be needed depending on patients' disposition status (i.e., admitted or discharged). Trauma patients who were going home expressed more concern in terms of the impact of pain on their ability to perform daily living activities and to work. In contrast, admitted patients were more likely to interpret their pain based on its aversive nature, their inability to get comfortable, and the potential risk for long-term consequences.

The contextual nature of pain interpretations. Patients in this study spontaneously reported that they did not interpret the acceptability of their pain solely on the basis of its intensity. When interpreting the meaning of their pain, they also considered factors specific to the traumatic event, activities occurring concurrently within the emergency department, as well as their past pain experiences and beliefs. Although no gender or age differences were observed in patients' pain interpretations, this may be due to the small sample size. Future studies might also investigate whether patients'

interpretations of their pain varies depending on the mechanism of injury (for example, sports-related versus work-related injuries).

Several pain myths were evident in patients' interpretations of acceptable trauma pain. These myths included: (1) a high intensity of pain is an inevitable and unavoidable consequence of trauma, (2) pain is the penalty for foolishness or lack of attention, (3) "good" patients don't complain of pain, (4) health care professionals know when a person is in pain without being told, and (5) analgesics are harmful and should be taken only when absolutely necessary. Such myths may have contributed to patients' high ratings for acceptable pain and acted as barriers to effective pain management.

Methodological Issues

Few would dispute that research within the emergency setting is needed. Research is an essential requisite of evidence-based practice and the critical evaluation of clinical outcomes. Because emergency departments are distinct from other in- or out-patient units, findings generated from studies conducted in other clinical areas may have limited applicability in an emergency department environment. In addition, the emergency care of patients may generate a unique set of clinical research questions. Despite this, research within the emergency department is a relatively new and unproven venture for researchers, clinicians, and patients. Few attempts have been made to investigate the experiences and treatment outcomes of patients in this clinical area. One possible explanation for the lack of research in this area is heightened concern for protecting the rights of patients who may be vulnerable as a result of a crisis event. A second explanation may be the methodological challenges encountered by researchers accessing this high acuity and rapidly changing clinical area.

Little has been written about methodological issues encountered when conducting research in such an active clinical environment. To date, studies pertaining to the emergency care of patients have relied predominantly on retrospective or cross-sectional designs, or utilized non-interactive methods of data collection, such as chart reviews, questionnaires, and videotaping. Although such approaches are methodologically easier to employ because they minimize the degree of interaction required between the researcher and the research participant, such designs are limited in the type of knowledge generated. Prospective and longitudinal studies are more appropriate for the investigation of pain due to the dynamic nature of this phenomenon as well as the contradictory findings in terms of the accuracy of recalled pain (Fors & Gotestam, 1996; Lowe & Roberts, 1988; McGorry, Webster, Snook, & Hsiang, 1999; Smith, Gracely, & Safer, 1998; Valdix & Puntillo, 1995).

Although careful planning and preparation are essential for the success of any research study, such preparation is especially critical when conducting research in an active clinical environment. Four methodological issues associated with the execution of

this study pertained to subject recruitment, data quality, the parameters of measurement, and delineating the role of the nurse-researcher.

Subject Recruitment

During the planning stage, factors were identified that could impede subject recruitment. Because traumatic injuries can happen at any time, there was no way to predict when eligible patients might arrive in the department. However to investigate the pain experience of trauma patients, it was important to commence data collection as soon as possible after the injury or at least after the patient's arrival in the department. In other words, the time lapse between patients' arrival in the department and their enrolment in the study should be minimized as much as possible. Due to the high acuity level and patient flow patterns experienced in this department, it was not feasible for emergency staff to assume the task of notifying the researcher upon the arrival of a potential subject. To address these factors, the researcher was present in the emergency department for designated hours throughout the period of data collection.

Due to the type of data collected, only one person could be enrolled in the study at any time. Potential cases were therefore missed. Although this approach may have reduced the representativeness of the final sample, the breadth of data collected generated a more in depth description of the stable trauma patients' pain experience.

An additional factor pertaining to the recruitment of subjects became evident during the actual data collection period. On a few occasions, the researcher conceded that the department was simply too busy to conduct research. During these periods, all available stretchers plus the waiting areas were filled. Noise and activity levels within the department increased, while waiting times were lengthened (e.g., for x-rays or transfers to inpatient units). These periods were extremely stressful for both staff and patients which reduced their tolerance for extraneous activities such as research. Strategies need to be identified that will permit researchers to conduct research during these times of heightened activity and increased patient congestion in order to investigate the impact of such periods on pain management practices.

Data Quality

Prior to data collection, the researcher spent time in the department in order to establish a rapport with the staff and to gain an appreciation for the practice norms and patient flow patterns. McGuire et al. (2000) considered familiarity with the setting to be key to the successful integration of a study into a clinical environment. Modifications were made to the study protocol in an attempt to streamline data collection with patient care as much as possible and to comply with the time and space constraints imposed by the clinical setting.

The quality of the physiological data was jeopardized by the decision to make do with available equipment. Valuable data were lost because the physiological monitoring equipment could only be used in areas with a power outlet. Many patients complained of unacceptable pain during periods when they were disconnected from the monitoring system for diagnostic tests (e.g., x-rays). In addition, a number of patients experienced periods of unacceptable pain following their relocation to the hallway. If the true relationship between physiological and verbal pain responses is to be established, equipment is needed that produces reliable, valid, sensitive and continuous measurements of the patients' physiological responses. To be effectively used in an emergency environment, monitoring equipment must also be portable, battery-operated, and compact. Ideally, it would interface with equipment currently used in the department so that research and clinical data could be collected simultaneously using one set of monitoring electrodes. For example, a dual purpose monitoring system would permit the use of chest rather than digital electrodes for monitoring cardiac and respiratory rates which should reduce measurement error caused by artifact. Reducing random error would improve the ability to detect patterns or trends in physiological measures.

Given the limitations of the monitoring equipment, the findings of this study offer only weak evidence to support the proposition that a relationship exists between patients' interpretation of their pain and their physiological responses (that is, activation of sympathetic branch of the autonomic nervous system). Muscle tension, as measured by the electromyogram, may provide some indication of the pain experience of men, at least during the early phase of trauma care. In this study, EMG measures consistently reflected the postulated changes for the six men, but not for the nine women. Several reasons may be offered to explain why the men's EMG responses more closely reflected postulated changes than the women's. One, previous research has been conducted primarily within the laboratory environment using healthy, adult males. This gender bias may have prevented the identification of inherent gender differences in sympathetic response patterns. Two, previous studies have relied primarily on the analysis of grouped data which may have masked such gender differences. And finally, the electrode placements used in this study may have contributed to the findings. Gender differences in the development of the frontalis flexor muscle may have affected the magnitude of EMG readings in that the muscle mass in men may be larger or more well-developed than in women.

Further research is needed to determine the relationship among pain and physiological responses. This knowledge is needed if we are to improve pain management practices for patients who are unable to provide verbal reports of their pain (for example, unconscious, critically-ill, and preverbal patients).

Problems were also experienced when using the VAS to measure pain intensity. According to the study protocol, VAS measurements were to be collected every 20 minutes. Unfortunately, it was not always possible to adhere to this time sequence due to

the assessment and treatment of patients. The pen and paper format of the VAS necessitates direct interaction between the researcher and patient. Consequently, measurements could only be collected during a lull in patient care. Although the primacy of patients' treatment needs must be acknowledged, such variability in the interval between measurements had a negative effect on the quality of the data collected, as well as the validity and generalizability of findings.

Other problems were also experienced with the VAS. Two elderly women were unable to use the VAS scale even after repeated instructions on its use. Positioning of the VAS line may also have biassed the measurements obtained from a third woman. Because similar limitations have been reported by other researchers (Bondestam et al., 1987; Carlsson, 1983; Hofgren et al., 1988; Puntillo, 1994), the utility of the VAS for clinical pain research warrants re-examination.

Parameters of Pain Measurement

The current norm in pain research is to measure one dimension of the patients' pain experience (usually intensity) using standardized tools. Recently, there has been a shift in this focus as a few researchers have attempted to link pain intensity to evaluative criteria (outcomes) such as quality of life, functional status, and satisfaction with care. However the generalizability of these findings is limited as the work has primarily been conducted in chronic malignant and nonmalignant pain populations (Cleeland, 1989; Cleeland, Gonin, & Hatfield, 1994; Ferrell, Grant, Padilla, Vermuri, & Rhiner, 1991; Padilla, Ferrell, Grant, & Rhiner, 1990). Little has been done in terms of the experience of acute pain. This knowledge gap is unfortunate because clinically meaningful criteria for interpreting the adequate relief of acute pain are urgently needed to guide and monitor pain management practices.

In this study, trauma patients were asked to identify criteria used to interpret the acceptability of their pain. Findings suggest that the patients considered a multiplicity of personal and contextual factors in this decision-making process. The clinical utility of this interpretative criteria might have been increased if patients had also weighted or ranked the relative importance of each criterion. Outcome measures consisting of individually-specified and weighted interpretative criteria have been recommended for the measurement of health status and quality of life (Feinstein, 1992; Tugwell, Bombardier, Buchanan, Goldsmith, Grace, & Hanna, 1987; Wright, 2000). Wright (2000) proposed that such measures are more valid and clinically meaningful than traditional measures in that they reflect the degree of individual variability in treatment expectations and goals. This approach may have merit for the measurement of pain due to the multi-dimensional and highly subjective nature of this phenomenon. However several challenges would be encountered with the use of such tools in active clinical environments. Such measurement tools would require the investment of time and effort by both the patient and the researcher and/or clinician to generate and weigh the interpretative criteria. One strategy

to expedite this process might be the creation of a pre-defined list of interpretative criteria from which patients could select. Guidelines would also be needed to address issues such as how ratings should be combined to create a summary score, whether to include all criteria or just the most important ones, how to deal with unrealistic or unachievable criterion, what to do if patients expressed a desire to modify their criteria during the course of treatment, and how to interpret scores on these tools. Despite these challenges, such measurement tools would provide a more accurate and comprehensive picture of patients' perceptions of their pain experiences.

Delineating the Role of Nurse - Researcher

Traditionally, the quantitative researcher has been portrayed as an objective, non-participant observer or recorder of events. Such depictions originated in the basic sciences and essentially abdicate the researcher of any responsibility in relation to the care and/or well-being of research participants. Although such a non-intrusive role may be appropriate for the basic sciences, it may not be justifiable for a practising profession such as nursing. For example, the relief of pain and suffering is generally accepted as an imperative of all health care professionals. Despite the potential for conflict between a professional's roles as researcher and clinician, this issue has received little consideration within the research literature.

In this study, the researcher's entry into the clinical setting was gained in part by her "being a nurse." This information was contained in both the patients' consent form and the information sheet circulated to the emergency personnel. Although these forms also indicated that involvement in the research study would not affect patient care, it is questionable whether such a clause abdicates health care professionals from their responsibilities to practice. For example, given current knowledge of the negative effects of unrelieved pain, is it acceptable for a nurse researcher to remain silent when a patient/research participant complains of unacceptable pain? Because this researcher could not justify such passivity, the following steps were taken in an attempt to advocate for patients who experienced unacceptable and/or high intensity pain while minimizing the degree of interference with current practice. If patients reported severe pain, they were encouraged to communicate this information to their nurse. In a few cases when patients exhibited acute distress, the researcher conveyed this information directly to an emergency nurse. Clearly such actions do not correspond with the traditional perspective of the quantitative researcher as an impartial bystander. In addition, this action undoubtedly impacted on the study findings. However it was assumed that this action would bias results in a consistent manner - improved pain management.

As the knowledge base for pain and its management increases, researchers must reconsider their role within the clinical setting. Rather than passively documenting inadequacies in pain management practices, clinical researchers should incorporate actions into their study protocols during the planning stage that reflect current knowledge and

treatment guidelines.

A final methodological issue that warrants consideration is the type of pain research needed to advance our knowledge base. More than a quarter century has passed since Marks and Sachar published their study documenting the severity of pain experienced by hospitalized medical patients (1973). Since then, research has repeatedly revealed that patients, of all ages with a variety of medical, surgical, or emergent conditions endure periods of moderate to severe pain. A partial listing of studies which have investigated pain management practices is presented in Appendix F. These studies conclude with a common recommendation - to improve current pain management practices. Rather than investing additional monies in studies describing the inadequacies of current practices, a more prudent and fiscally responsible course-of-action might be to direct our limited resources to studies designed to prevent the negative immediate and long-term consequences of unrelieved pain.

Recommendations

For Research

Findings of this study raise a number of issues in terms of the current norms for pain measurement. Although the VAS is popular with researchers as it generates interval-ratio level data which permit parametric statistical analyses, this advantage may be negated by the fact that VAS pain scores are not interpreted in any systematic manner. The extreme variability observed in patients' interpretations of scores on the VAS, in terms of what constitutes an acceptable level of pain, suggests that inter-individual comparisons of pain scores may not be justifiable. This variability in the interpretation of scores may reflect the highly subjective and multidimensional nature of pain. Given this, it may not be possible to establish norms for interpreting VAS scores for a specific population or context. Perhaps the interpretation of pain scores should be limited to intra-individual (ipsative) comparisons. A critical analysis of the utility of the VAS for the measurement of pain is urgently needed. In the interim, alternative pain measurement tools should be evaluated. For example, categorical scales with clearly defined labels may generate more meaningful scores by which to interpret the adequacy of pain management practices.

The effectiveness of pain management within the emergency department is undoubtedly affected by the quality of interactions between the patient and health care professionals (i.e., physicians and nurses). Because nurses play an essential role in the assessment of pain and subsequent administration of pain-relieving interventions, research is needed that simultaneously investigates the pain experience as interpreted by the patient and the nurse. Factors influencing patients' interpretations and subsequent responses to the experience of pain, and nurses' interpretations and reactions to the patient's pain response need to be identified. Simultaneously, strategies designed to enhance the quality of such nurse-patient interactions and thereby improve clinical decision-making and

actions for the management of pain need to be identified and tested. Given the dynamic nature of pain, longitudinal studies are also needed to examine the recovery trajectory and clinical outcomes of patients experiencing pain in various clinical settings. Such studies would also permit an examination of the changes that occur in patients' interpretations of pain over time.

For Practice

The first step in the effective management of pain is assessing it. The findings of this study suggest that many factors affect how patients interpret their pain experience. To understand the meaning of a patients' pain, nurses must assess not only the severity of the pain, but also the meaning that patients attach to it. Assessing both of these dimensions will permit nurses to more effectively respond to their patients' pain.

Findings of this study highlight some of the challenges of managing pain in active clinical areas. To improve pain management practices, explicit criteria for interpreting patients' pain scores and linking these scores to treatment goals need to be established. Until the clinical utility (i.e., trustworthiness, accuracy and meaningfulness) of scores on our pain measurement tools has been established, pain measurement will not attain the status of the traditional vital signs. Such work will require the collaborative efforts of researchers, clinicians and those experiencing pain.

Despite the acute and traumatic nature of their injuries, several patients acknowledged the value of the supportive or comfort measures they received. This finding helps validate the important role that nurses can play within the emergency setting. Regrettably, the ability of emergency nurses to meet patients' needs for emotional and physical care may be hampered due to current trends in health care. Due to the structure and functioning of the unit, few patients were cared for by only one nurse. This was due in part to the movement of patients between various treatment areas within the department. In addition, many patients eventually ended up in the hallway while waiting for diagnostic results. Whether effective nurse-patient interactions or pain management can take place in an active thoroughfare is an issue that warrants consideration.

Conclusion

In an editorial entitled *When will adequate pain treatment be the norm?*, Hill (1995) proposed that the key to effective pain management may be to empower patients to demand adequate relief. Findings of this study suggest that more fundamental work is required. Adequate pain treatment will not be the norm until meaning is attached to the scores on pain measurement tools, and these scores are explicitly linked to treatment goals. These interpretative criteria need to be understood and accepted by both health care professionals and patients.

Establishing the reliability, validity, and clinical utility of the scores on pain measurement tools is especially critical as clinical areas increasingly adopt these tools as quality control indicators. Rather than investing resources on the development of new tools, a concerted effort should be directed to attaching meaning to scores on pre-existing instruments. Such work will require the collaborative efforts of researchers, clinicians, and those who are experiencing pain. Despite its popularity, the suitability of the VAS for measuring the phenomenon of pain warrants re-examination. Although the relative simplicity of the VAS makes its use appealing, the utility of a uni-dimensional measure for such a complex, multidimensional phenomenon is debatable. More than five years have past since Streiner and Norman (1995) suggested that scores on the VAS merely project an illusion of precision. Unfortunately, the validity of this statement or its implications for pain measurement have not been established. Such issues warrant consideration.

In conclusion, it is important to appreciate that health care professionals working in this emergency department were neither uncaring or inexperienced. The comments and actions of the nursing staff clearly indicated their desire to provide patients with the best possible care while ensuring their safety. These nurses readily acknowledged that pain is a frequent outcome of trauma and that it is detrimental to their patients' recovery. It is therefore proposed that problems observed in trauma pain management may be attributed in large part to the complexity of the phenomenon and the vagueness of current treatment goals. Although conducting research in active clinical environments poses many challenges, the knowledge gained may provide a more accurate depiction of the realities of current practice. Future clinical research should attempt to embrace the complexity of pain and its management rather than control it.

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Appendix A

Copy of Approval from University Ethical Review Committee

University of Alberta
Edmonton

Faculty of Nursing

Certification of Ethical Acceptability for Research Involving Human Subjects

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NAME OF APPLICANT(S): Marilyn Hodgins, PhD Candidate

TITLE OF PROJECT: "Interpreting the Magnitude and Meaning of Change in the Pain Experience of Patients with Traumatic Injuries"

The members of the review committee, having examined the application for the above named project, consider the procedures, as outlined by the applicants, to be acceptable on ethical grounds for research involving human subjects.

13 Jan 97
Date

Beverley O'Brien
Beverley O'Brien, DNS
Chair, Ethics Review Committee

ERC 97-130
Apr95-02-130

Appendix B

Copy of Approval Regional Health Authority Ethical Review Committee

Capital Health Authority

Regional Research Administration Office
CSB 9-122, 492-1372

Memorandum

NOTICE OF APPROVAL FOR PROPOSED RESEARCH
UNIVERSITY HOSPITALS SITE

Project Title:	Interpreting the Magnitude and Meaning of Change in the Pain Experience of Patients with Traumatic Injuries
Project No.:	H-45
Investigator(s):	Marilyn Hodgins
Department:	Faculty of Nursing
Division:	-
Address:	CSB 3rd Floor
Phone/FAX:	492-6836

Supporting documents:

1)	Ethical Approval	June 1997
2)	Study Protocol	Received
3)	Funding Source	NHRDP Student Fellowship, Health Canada, AHFMR Student Research Stipend
	b) Type	Grant
4)	Overhead Negotiated	N/A
5)	Account #	H of A - Faculty of Nursing
6)	Contract	N/A

Project Approved June 1997

THIS APPROVAL IS VALID FOR ONE YEAR

By _____

Title David Kay, Director
Professional / Technical Affairs

Copies to: Department Chair/Health Sciences Faculty Person

June 18, 1997

Appendix C

Consent Form

Consent

- Project Title -

Interpreting the Magnitude and Meaning of Change in the Pain Experience of Patients with Traumatic Injuries

Investigator:
Marilyn J. Hodgins, RN, PhD Candidate
Faculty of Nursing, University of Alberta
Telephone: 492-6836

Supervisor:
Dr. Janice Lander, Associate Dean of Research
Faculty of Nursing, University of Alberta
Telephone: 492-6317

Reason for Study:

- To examine the pain experienced by people following an injury.
- To examine how your body reacts to pain.
- To identify factors that cause people to change their rating of the severity of their pain.
- To find out how people decide whether or not their pain is at an acceptable (okay) level.

Description:

- Every 20 minutes, you will be asked to briefly describe any pain that you are experiencing, and how it has changed since the last time you described it.
- You will also be asked whether or not your pain is at an acceptable level, and to explain why.
- Your answers to these questions will be tape-recorded.
- Electrodes will be placed on your skin using sticky patches to see how your body reacts to any pain you may experience.
- A record will be kept of any medications and treatment you receive during your stay in the emergency department.
- The study will last for four hours, or until you leave the emergency department (which ever happens first).

Benefits & Risks:

- Whether or not you take part in the study will not affect the care you receive by the doctors and nurses in the emergency department.
- The doctors and nurses in the emergency department know about the study.
- There are no apparent risks involved with taking part in this study.
- Although you may not experience any benefits from taking part in this study, the findings may help others.

Voluntary:

- You do not have to take part in the study.
- You do not have to answer a question if you don't want to.
- You can drop out of the study at any time just by telling one of the nurses or the person collecting this information.

Confidential:

- Your name and the information that you give will be kept confidential.
- Your name will not be used in any paper or talk about this research.
- The information collected in this study may be used again. However before this will be allowed, permission will be obtained from an Ethical Review Committee.

Consent:

I am willing to take part in this study. My questions about the study have been answered. I have been given a copy of this form to keep.

_____ _____

Signature of Subject **Date**

Appendix D

Emergency Staff Information Sheet

Information Sheet

- Project Title -

Interpreting the Magnitude and Meaning of Change in the Pain Experience of Patients with Traumatic Injuries

Investigator:
Marilyn J. Hodgins, RN, PhD Candidate
Faculty of Nursing, University of Alberta
Telephone: 492-6836

Supervisor:
Dr. Janice Lander, Associate Dean of Research
Faculty of Nursing, University of Alberta
Telephone: 492-6317

Who I Am

- I am a Registered Nurse.
- I have worked in a variety of emergency departments both as a staff nurse and a clinical educator.
- Currently, I am conducting this study as part of my doctorate in nursing program at the University of Alberta, Faculty of Nursing.

Description of Study

- Few studies have examined the pain experiences of emergency patients.
- In this study, I will examine the pain experienced by people following a traumatic injury.
- During the patient's stay in the emergency department (ED), I will collect information on the patients' verbal ratings of their pain as well as physiological measures that may indirectly reflect pain severity.
- I am particularly interested in the changes that occur in patients' pain over time, and how patients interpret these changes. To obtain this information, I will ask patients a few simple questions.
- Without interfering with the patient's care, I will collect this information every 20 minutes for a period of four hours or until the patient is discharged from the department.
- Because nurses play a major role in pain management, I am also interested in the factors that emergency nurses use in making decisions about their patients' pain and its management.

What Will You Have to Do

- You will be asked to take part in the study if you are primarily responsible for the continued care of a patient enrolled in the study.
- It will involve about 5 to 10 minutes of your time.
- I want you to describe the factors you considered when assessing the patient's pain, and determining whether or not the patient's pain was at an acceptable level.
- This discussion will take place at a time convenient to you. Ideally it will occur soon after the patient's discharge from the ED or before your shift ends.
- To expedite this process, I would like to tape-record your comments.

Benefits & Risks

- There are no apparent risks involved with taking part in this study.
- Although you may not experience any benefits from taking part in this study, the findings will provide useful information regarding the pain experience of emergency patients.

Confidential

- Your name and the information that you give will be kept confidential.
- Your name will not be used in any paper or presentation about this research.
- The information collected in this study may be used again. However before this occurred, permission would be obtained from an Ethical Review Committee.

Voluntary

- You do not have to take part in the study.
- Before a patient under your care is asked to participate in the study, your verbal agreement will be obtained.
- You can opt out of the entire study at this or any other time simply by completing the form at the bottom of this page, and returning it to me.

Additional Questions

- I would be happy to answer any additional questions you have about this study.

Opt Out

I do not want to take part in the study entitled *Interpreting the Magnitude and Meaning of Change in the Pain Experience of Patients with Traumatic Injuries*.

Signature _____ **Date** _____

Appendix E

Congruency between Postulated and Observed Electromyography Changes

A. Men

Case	EMG Readings	VAS Pain Intensity	Acceptability Rating
1	5.05	38	Unacceptable
	3.92	38	Unacceptable
	1.06	*18*	*Acceptable*
2	5.58	79	Unacceptable
	6.79	69	Unacceptable
	4.68	*42*	*Acceptable*
	4.71	*29*	*Acceptable*
3	5.42	73	Unacceptable
	4.21	68	Unacceptable
	2.38	36	Unacceptable
	2.42	29	Unacceptable
	0.94	*16*	*Acceptable*
4	5.22	52	Unacceptable
	3.25	*32*	*Acceptable*
	1.99	*32*	*Acceptable*
	1.83	*8*	*Acceptable*
	1.13	*8*	*Acceptable*
	1.40	*8*	*Acceptable*
	2.25	*8*	*Acceptable*
	1.01	*1*	*Acceptable*
5	*.84*	*31*	*Acceptable*
	1.42	44	Unacceptable
	4.59	49	Unacceptable
6	6.71	77	Unacceptable
	8.59	77	Unacceptable
	.75	*55*	*Acceptable*
	1.53	*75*	*Acceptable*
	4.06	85	Unacceptable

Note. Guidelines for interpreting EMG values: $\geq 2\mu V$ (kilovolts) indicative of muscle tension, between 1 and $2\mu V$ normal tension, and $\leq 1\mu V$relaxed (Rodger, 1996). *Italicized print* indicates congruency between postulated and observed readings.

B. Women

Case	EMG Readings	VAS Pain Intensity	Acceptability Rating
7	1.93	86	Unacceptable
	4.66	72	Unacceptable
	3.92	89	Unacceptable
	6.80	66	Acceptable
	3.19	66	Acceptable
	5.61	65	Acceptable
	4.88	65	Acceptable
8	2.18	77	Acceptable
	4.81	87	Unacceptable
	4.02	79	Acceptable
	2.00	54	Acceptable
	2.81	54	Acceptable
	3.07	53	Acceptable
	4.96	35	Acceptable
9	0.95	88	Unacceptable
	7.16	75	Acceptable
	0.86	64	Acceptable
10	3.00	52	Acceptable
	4.43	65	Unacceptable
	2.12	75	Unacceptable
	2.16	85	Unacceptable
	.73	53	Acceptable
	1.91	53	Acceptable
11	4.83	25	Acceptable
	4.53	19	Acceptable
	3.59	14	Acceptable
	3.90	23	Unacceptable
	4.53	9	Acceptable
	2.40	9	Acceptable

Women cont'd

Case	EMG Readings	VAS Pain Intensity	Acceptability Rating
12	3.74	18	Acceptable
	2.75	30	Unacceptable
	2.50	27	Acceptable
	1.05	27	Acceptable
	1.20	27	Acceptable
	3.10	27	Acceptable
	3.05	20	Acceptable
13	1.51	35	Acceptable
	1.74	39	Acceptable
	1.27	29	Acceptable
	2.05	29	Acceptable
	4.54	81	Unacceptable
	1.41	29	Acceptable
14	2.82	70	Unacceptable
	6.61	64	Acceptable
	5.44	24	Acceptable
	7.14	24	Acceptable
15	4.54	73	Acceptable
	5.73	73	Acceptable
	2.83	73	Acceptable
	3.58	73	Unacceptable
	2.46	73	Acceptable
	3.28	73	Unacceptable
	4.72	83	Unacceptable

Note. Guidelines for interpreting EMG values: $\geq 2\mu V$ (kilovolts) indicative of muscle tension, between 1 and $2\mu V$ normal tension, and $\leq 1\mu V$ relaxed (Rodger, 1996). *Italicized print* indicates congruency between postulated and observed readings.

Appendix F

Studies Investigating Pain Management Practices

Authors	Clinical Setting & Sample	Findings
Arblaster, 1995	- Emergency Department (ED) - 40 men with leg fractures	- All patients had pain with movement, 55% had pain at rest - More than (>) 80% waited > 2 hours for analgesia - Less one (<) one-quarter received analgesia in ED
Beyer, Ashley, Russell, & DeGood, 1984	- Surgical Unit - 50 adults & 50 children - Post-cardiac surgery	- Only 30% of analgesics administered were given to children - Younger the child, fewer analgesics given - Six received no analgesia. All were children (mean age = 1.05) - No documentation of pain assessment
Bondestam, Hofgren, Johansson, Jern, Herlitz, & Holmbert, 1987	- Intensive care unit - 47patients with possible acute myocardial infarct	- 20% of patients with pain scores of 7 to 8 received no analgesics - 37% of analgesics gave no pain relief
Closs, 1990	- Surgical unit - 36 patients (20 complained of sleep disturbances due to pain and 16 did not)	- Less analgesia given during night than day - Patients given only 30 to 35% of prescribed analgesia - No difference in analgesic use between two groups
Cohen, 1980	- 5 hospitals - 109 surgical patients	- 3/4rds reported moderate to marked pain - 67% stated pain interfered with sleep - 38% stated pain more severe than expected - Despite this, >3/4rds indicated adequate pain relief
Desbiens et al., 1996	- Five teaching hospitals - 5176 seriously ill patients	- 50% reported pain at time of interview - 15% reported experiencing extremely to moderately severe pain at least half of time - 15% dissatisfied with how pain managed
Donovan & Dillon, 1987	- Oncology Unit - 96 patients with cancer	- > 50% reported episodes of horrible or excruciating pain - Only 43% recalled nurses discussing pain with them - Pain frequently disturbed sleep

Authors	Clinical Setting & Sample	Findings
Donovan, Dillon, & McGuire, 1987	- Medical-Surgical Units - 353 randomly selected patients	- At interview, 46% reported pain - > half reported excruciating pain - < half had a health care provider ask them about pain - < half of charts had any pain documentation - < one-quarter of prescribed analgesic administered
Gillies, Smith, & Parry-Jones, 1999	- Surgical units - Adolescents (287 in-patients and 64 day cases)	- 50% rated pain as moderate or severe on first post-operative day - By day 3, 35% continued to complain of moderate or severe pain - No evidence of systematic pain assessment
Lavies et al., 1992	- Surgical Units - 53 cholecystectomy patients 3rd day post-operative	- Patients had low expectations of pain relief - Patients reluctant to request analgesics - 1/3rd did not obtain a lot of relief from analgesics - 29% experienced pain worse than expected - Despite this, 92% satisfied with pain relief
Marks & Sachar, 1973	- Medical Unit - 37 patients	- About three-quarters experienced moderate to severe distress despite analgesics - Analgesics under-prescribed and under-administered - 31% had pain lasting > 4 days
Melzack, Abbot, Zackon, Mulder, & Davis, 1987	- Surgical Unit - 88 post-operative patients	- Patients with long-lasting, post-operative pain helped less by prescribed medications - Patients with persistent pain tended to be older, received less potent drugs and smaller doses
Owen, McMillan, & Rogowski, 1990	- Surgical Unit - 259 post-operative patients	- Patients lack knowledge of pain and its management - 2/3rds would not ask for analgesics until in severe pain - > half of patients reported moderate to severe pain
Puntillo, 1994	- Critical Care Unit - 90 patients (45 undergoing suctioning) (35 chest tube removal)	- Higher pain scores with chest tube removal - Almost half of chest tube patients and 88% of patients suctioned had no analgesic in hour prior to procedure
Puntillo, 1990	- Critical Care Unit - 24 patients	- 63% rated pain as moderate to severe - Intubated patients described difficulties communicating pain - No correlation between amount pain recalled and analgesic given

Authors	Clinical Setting & Sample	Findings
Roberts & Eastwood, 1994	- Hospital - 100 patients with femur fractures	- Only 2 reported no pain - Of 98 patients with pain, 89 rated pain as >7 out of 10 - 1/3rd received no analgesia in ED
Sun & Weissman, 1994	- Surgical Intensive Care Unit - 150 patients	- Only 22 - 52% of prescribed medication administered - More given to intubated patients - Physicians' orders lacked specificity
Tanabe & Buschmann, 1999	- Emergency department (ED) - 203 adults	- pain was chief complaint of 79% of patients - average pain rating 6.1 (out of 10), SD=2.9 - 47% of patients with pain received analgesic, after waiting average of 74 minutes - only 15% of sample received opioid - chest pain most often treated with medication (abdominal pain least)
Ward & Gordon, 1994	- Hospital - 217 adults - 31children	- Little relationship between patient satisfaction and severity of pain - Mean pain severity during past 24 hours was 6.6 (0-10 scale) for adults and 4.3 (0-5 scale) for children
Warnock & Lander, 1998	- 3 hospitals (Day Surgery) - 129 children - post-tonsillectomy	- $\bar{x}$ VAS pain post-op day 66.6 (sd=32.7) - $\bar{x}$ daily VAS pain ratings 64.8 (sd=29.2) on Day 1 to 26.8 (sd=25.0) by Day 7
Wilson & Pendleton, 1989	- Emergency Department - 198 charts of patients with acutely painful conditions	- 55% received no analgesia - Of those who received analgesia, 42% waited >2 hours